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OBITUARIES

MARINUS VAN DEN ENDE

After four years of an illness, the final outcome of which was tragically inevitable, Marinus van den Ende, Dean of the Faculty of Medicine and Professor of Bacteriology in the University of Cape Town, died on June 4, 1957, at the early age of 45.

He was born in 1912, the second son of Dutch parents, his father being the local pharmacist at Potgietersrus. He received his schooling in his home town, proving to be an exceptional pupil and finally matriculating at the early age of 15. For one so young, the move from home in a small northern Transvaal town to embark upon a course in medicine at the University of Cape Town might easily have proved disastrous. However, the young student applied himself whole-heartedly to his studies and finally graduated after six years with distinctions in anatomy, physiology, bacteriology, psychiatry and surgery. He served his internship in the New Somerset Hospital and in 1935 joined the staff of the Department of Pathology as a junior assistant under Professor B. J. Rytie.

On the award of the second John Lucas Walker Studentship in 1937, van den Ende decided to undertake research for the Ph.D. degree in pathology at the University of Cambridge. His work here was in the field of anaphylaxis. During his stay in Cambridge he met Sir Henry Dale, then Director of the National Institute for Medical Research. This meeting undoubtedly shaped van den Ende's future career. Sir Henry, appreciating the promise shown by this young man from South Africa, readily agreed to a suggestion that van den Ende should move to the Institute at Hampstead for the remainder of his second year. Here, working side by side with some of the most eminent medical research workers in Britain, he quickly won high regard for his ability, character and personality.

At the beginning of 1939, when he had been at the Institute for only a few months, he was offered a post on the staff. This he refused, feeling that his duty lay in a return to his native land. He did, however, obtain leave to remain until the end of the year. The rapid deterioration in international relationships which took place in this period led him to review his earlier decision; with the writing on the wall plain for all to see, he decided that his duty lay with medical research in Great Britain during the impending conflict. It was to be another seven years before he was to return to South Africa.

During these years he worked on a variety of problems of major importance to the war effort. He investigated methods for the prevention of aerial cross-infection in hospitals and for the development of a safe and reliable method of vaccination against typhus. He was chosen for the very responsible position of organizing and directing a research unit for the production of a vaccine against scrub typhus, a disease which was proving extremely costly to the armies fighting in the jungles of the Far East. Commissioned as a major in the R.A.M.C., he saw service in North Africa and Italy, making controlled tests on the prophylaxis and chemotherapy of typhus.

Shortly after the conclusion of hostilities he was appointed to the Chair of Bacteriology in the University of Cape Town, a post which he held until his death. In this post, he was not only responsible for the teaching of bacteriology in the medical

curriculum but also for the provision of the routine bacteriological services to the Groote Schuur and other teaching hospitals in Cape Town. These duties he undertook with a zest and sense of responsibility which was characteristic of him in all that he did. He quickly established himself as a first-class teacher, alive to his subject and eager to transmit his enthusiasm to his pupils. His ability as an organizer also soon became apparent and he found himself in demand for the valuable advice which he could give as member of several University committees.

But van den Ende the scientist was not content with these activities. His heart lay in research and he rapidly set about building up a research school in bacteriology with particular emphasis on the study of viruses. Medically trained himself, he was awake to the essential part the fundamental sciences could play in this field. He was eager to enlist the support of specialist chemists and physicists and frequently bemoaned the fact that he had not had more training in these subjects himself. His indefatigable energy and devotion to research soon attracted the attention of the recently created Council for Scientific and Industrial Research. Pursuing its policy of providing facilities for proved research workers, the Council created a Virus Research Unit with van den Ende as director. With a chemist, a physicist and a number of biological workers drawn from his own staff, he set about welding them into a team. The effectiveness of this team is apparent in the work which has been published from the Unit. Some seventy papers cover work in bacteriophages, influenza, poliomyelitis, lumpy-skin disease, rabies, Rift Valley fever, blue tongue, physical studies of viruses, and general methods in virus research. It was to van den Ende's personality and research ability, to a great measure, that this effectiveness was due. He was quick to appreciate the significance of results obtained in one field with respect to another. He had a deep insight into the problem at hand, a genius for getting right down to the fundamentals of it, and working up from them, step by step, to a final solution. His enthusiasm was infective and drew the best from his collaborators. Critical, of himself as well as others, he would only accept results fully corroborated by exhaustive experimentation; quick to recognize worth in others, he was always ready to offer encouragement and, although actively engaged in a problem by his contributions in thought and advice, he would never put his name to a paper unless he had actually participated in the performance of the experimental work himself. Van den Ende was a scientist, an exceptional scientist, burning with a deep love for his subject and the pursuit of truth.

His work as a researcher brought him both national and international recognition. He was a chairman of the medical and dental advisory committee to the Council for Scientific and Industrial Research and, later, a member of the Council itself. He was an adviser to the World Health Organization on influenza and a member of the Technical Advisory committee to the Poliomyelitis Research Foundation. In 1954 he was appointed a member of the Commission of Enquiry charged with the investigation of the 'possibility of better co-ordination of medical research in the Union . . .'. He was elected a Fellow of the Royal Society of South Africa in 1954 and in October 1956 was the first recipient of the silver medal of the South African Medical Association 'for exceptional original research and valuable contributions to the advancement of medical science and the art of healing'. In March 1956 he was invited to participate in a Ciba Foundation Symposium on Viruses.

His success in achieving so much is all the more remarkable since he was working very much in isolation in Cape Town. He had little opportunity of visiting other virus research laboratories and of discussing his researches with other international experts. In 1953, Sir Arthur Sims made it financially possible for him to spend some time in the laboratories of Sir Macfarlane Burnett in Melbourne, Australia. Here he was able to acquire the techniques involved in the 'crossing' of virus strains working on the influenza virus. Returning to Cape Town, he applied these techniques

to the poliomyelitis group of viruses. It was during this visit that the first sign of his illness became apparent. Of this time in Australia, Sir Macfarlane Burnett writes:

Rinus van den Ende spent a few months in my laboratory during 1953. It was a visit that had been made possible by a generous benefactor (Sir Arthur Sims) and it opened in the happiest fashion. 'Van' and his wife found themselves completely at home amongst Australians, they had a pleasant apartment, and there were plenty of opportunities during the sunny Autumn to see something of the shape and life of our part of the world. In the laboratory van den Ende joined forces with the group working on influenza virus genetics and was soon enthusiastically immersed in the important and still incompletely resolved question of the redistribution of virulence amongst the progeny of double infections by a virulent and a non-virulent strain of influenza virus. He and Perry were the first to demonstrate that such redistribution of the virulence occurs. There was much other work going on and van den Ende was soon very much one with the rest of us in his enthusiasm for the influenza virus.

Then following a short visit to New Zealand there came the persistent respiratory infection which led to the recognition of the malady which was to prove fatal four years later. It was a grievous blow to him and to all of us. Even at that stage there could be little doubt about the diagnosis or the ultimate outcome. The only thing to be done was for him to return to South Africa and on his home soil see the thing through. Others can tell of the courage and effectiveness with which he carried on to the end. For us the visit ended when we said goodbye at the airport, a midnight farewell of forced cheerfulness, sadly in contrast with the happy arrival four months previously.

'The courage and effectiveness with which he carried on to the end' in the face of an illness, the course of which he knew only too well, will long remain in the memory of those who knew him during this period. He returned to South Africa to take on even more duties. Maintaining his teaching and research, he became the full-time Dean of the Faculty of Medicine and his administrative responsibilities became a heavy load. These duties were all the more onerous owing to the recent establishment of the Joint Medical Scheme between the University and the Provincial authorities and involved his attendance at numerous committees of both bodies. He also became the University representative on the Medical and Dental Council. Further demands were made on him with the establishment of the new medical school at the University of Stellenbosch; when his advice was sought, he was always ready to give it freely and his colleagues in the sister university were able to benefit by his wide experience and balanced judgments.

The passage of time, however, made it clear that he was being asked to do too much, and some relief from his arduous duties became essential. But, although arrangements were made to lighten his load and allow him to devote more time to the research he loved in the fast ebbing time which was still left to him, fate was to strike again. The death of the Principal, Dr. T. B. Davie, in December 1955, was a severe blow to all the many aspects of the University's activities. But in none more so than in the medical school. Dr. Davie, a medical man himself, had maintained a very close interest in the affairs of the Faculty of Medicine. He, as Principal, and van den Ende as Dean, were very much involved at this time in negotiations with the Provincial authorities on the financing of the Joint Medical Scheme which had become a very severe drain on University funds. With matters at a critical stage, van den Ende was once again approached with a request that he remain in office as a part-time dean. His sense of duty was such that he readily accepted, and it was with great fortitude that he carried these heavy responsibilities to the end. On many occasions he was forced to rest, but even at these times he was often to be found in bed surrounded by a mass of agendas, journals, or the manuscripts of scientific papers and reports; those seeking advice were never turned away.

Those who knew Marinus van den Ende will always count it a great privilege. He was an intellectual giant who inspired all those who came in contact with him, in the classroom, in the laboratory and around the committee table. He was a humble

man, a man conscious of his own deficiencies rather than his success. His charming personality and approachability endeared him to all, student and colleague, friend and acquaintance; his conversation always held the listener and his ability to tell a good story made him a welcome guest on social occasions. His interests were wide; he enjoyed an afternoon at Newlands watching rugby football—at the time of his death he was president of the University Rugby Football Club; a day in the country by stream or vlei with a trout rod in his hand or tramping the veld with a gun by his side gave him much pleasure; he was a competent amateur carpenter; reading and listening to music provided him with relaxation, and at one time he took up painting as a hobby. But interests were never allowed to come before duty; devotion to duty and scientific research was the guiding principle of his life.

In 1939, while in London, he married a fellow South African, Joan Herold Barry, whom he had known in Cape Town. Throughout his subsequent career, her devotion counted for much, at no time more than during the period of his illness when he was sustained by her courage, understanding and companionship. She and their four children, Jan, Pieter, Joan Ida and Marina, survive him.

Thanks are due to Sir Henry Dale, for making available the manuscript of an obituary he had written for *Nature*, and to Sir Macfarlane Burnett for the note quoted above.

F.G.H.

• • •

MARIA WILMAN

1867–1957

'For rigorous teachers seized my youth,
And purged its faith, and trimm'd its fire,
Shew'd me the high white star of Truth,
There bade me gaze and there aspire.'

Maria Wilman, the fifth of a family of nine daughters, was born at Beaufort West all among the sheep-farmers in the heart of the Karroo. Her father, Herbert Wilman, came to South Africa as a lad from Thornton in Yorkshire, and her mother, Engela Johanna Neethling, was born in the Prince Albert District, where her father was a farmer. The Rev. J. H. Neethling of Stellenbosch, one of the founders of the Victoria College, was her brother, and Advocate J. H. Neethling, one of the founders of the South African College and a member of its Council for years, an uncle. During the complications and troubles arising from the emancipation of the slaves Miss Wilman's maternal grandfather had trekked to Klaarstroom, near Meiring's Poort, and it was in this lovely part of the country that her parents first met. Mr. Wilman was afterwards associated in business with Mr. (afterwards Sir John) Molteno, 'The Lion of Beaufort', and represented that constituency in Parliament from 1879 to 1883.

In 1885 Miss Wilman's school-days at the Good Hope Seminary, Cape Town, had ended and her university life at Cambridge had begun. She was perhaps the second South African to enter Newnham College, the first probably being Sir John's eldest daughter, Elizabeth Molteno, who was there in 1884. Miss Clough (aunt of the poet, A. H. Clough, who is commemorated in Matthew Arnold's great elegy, *Thyrsis*), the first Principal, still reigned. Those were early days, and until additional

halls could be built private houses were used, with a vice-principal in charge. Miss Wilman's vice-principal was Miss Gladstone, daughter of the great Liberal and a woman of strong character. During the first period at Cambridge she took a science tripos in geology, mineralogy and chemistry, and during the second period, which began in 1888, her chief study was botany. At that time only certificates were given to women and it was not until November 1931 that the Degree of Master of Arts was conferred upon her. ('It has taken some time', she might have said by way of explanation, 'for the authorities to confirm the poetically expressed assertion—that woman is part of man—which was made by the author of *Genesis*.')

Her association with the South African Museum began soon after her return from England and lasted until 1908, when she was appointed Director of the Alexander McGregor Memorial Museum in Kimberley. They were full and happy years, and she often spoke affectionately of 'the old Museum days', of the interesting friends she made there and the fine work they were doing; and all the time she was helping others she was herself unconsciously receiving the best training that could have been devised for the great undertaking that was to occupy more than forty years of her life. It was while she was assisting Dr. G. S. Corstorphine, the first Professor of Geology to be appointed in the South African College (1895-1902) and Director of the Geological Survey of South Africa, that her 'Catalogue of printed books, papers and maps, relating to the Geology and Mineralogy of South Africa' was made. This was published in the *Transactions of the South African Philosophical Society*, Vol. XV, 1904-5, pp. 283-467. Her services were for the most part voluntary, which pleased the pater-familias, who did not approve of a daughter of his working for a salary. It was only later that he realized he had a Newnhamite to deal with in this matter.

The Alexander McGregor Memorial Museum was the munificent gift of Mrs. Margaret McGregor to the people of Kimberley in memory of her husband, who was Mayor of Kimberley in 1886. In addition to the land and building the gift included invested funds to be used for the upkeep of the fabric of the building. There were happy talks between the donor and the newly appointed Director at Forest Lodge, Rondebosch, when Mrs. McGregor could express her own ideals, hopes and wishes, and Miss Wilman could unfold some of her plans for making the Museum worthy of the name it bore. In this way the generous old lady had the joy of placing the care of her gift personally in the hands of Miss Wilman, who thereby became solemnly dedicated, as it were, to the charge she was to hold, officially, for more than thirty-eight years. The building was not quite finished when she arrived in Kimberley in March 1908, and the first exhibit-cases did not come until May. By September these had been placed, the then available exhibits arranged and the Museum opened to the public—six months of heavy going, some in bitterly cold weather, made a good start.

Then began the exploration of Griqualand West from the Museum point of view. Miss Wilman kept in close touch with the local farmers, officials, diggers, and every other likely person she could find to help her in this gigantic task. For none knew better than she that 'the harvest truly is great and the labourers few' and that 'he that sleepeth in harvest causeth shame'. Most of these collectors needed her guidance, and 'many an alluvial diamond-digger was taught by her to recognize, and preserve for the Museum, bones and tools from the gravel terraces and beds of the Vaal and Hartz rivers'. She was called (in private) 'Why don't you?', because the tactful 'Why don't you do—this or that?' was her usual way of rousing an interest in the growth of the Museum and of urging people to make additions to the collections it already contained. By the force of her own example, which far outshone her precept, these exhortations produced such fine collections that, when she relinquished its directorship, the Alexander McGregor Memorial Museum held its place among the leading, and much older, museums in South Africa—a truly remarkable achievement,

considering the short time taken for its fulfilment. That she managed to keep so many irons in the fire at once, and all aglow, remains a marvel.

In 1910 the first publication emanating from the Museum was issued—'Notes on some Bushman Paintings in the Thaba Bosigo District, Basutoland', followed in 1918 by 'The Engraved Rock of Loë, Bechuanaland Protectorate'. Both were by M. Wilman and were published in the *South African Journal of Science*. Next came the Duggan-Cronin books, all published by the Museum—*The Bushman Tribes of Southern Africa* (1942, containing 40 plates, with the letterpress by D. F. Bleek) and *The Bantu Tribes of South Africa* (1928–54). In all, eleven Sections of the latter were produced, making four volumes (demy 4to) and including as many as three hundred and fifty-six of the late A. M. Duggan-Cronin's incomparably fine photographic studies of native life, reproduced in sepia. Six of these Sections are now sold out—a proof of the warm reception this important and extensive work, a perfect example of excellent production by the Cambridge University Press, received from the public. Mr. Cronin had spent 'some twenty years among the heterogeneous collection of South African natives in the compounds of the De Beers Consolidated Mines, Kimberley', making photographic studies which Miss Wilman describes as being 'not only artistic in themselves, but singularly true to life' and 'of considerable ethnological value'. But she felt 'these pictorial records had their limitations in that they were mostly portrait studies, and studies moreover of males only', and 'that greater scope for his talents would be attained by a friendly co-operation with the Museum Board in the native territories of South Africa in securing, while there was yet time, a useful and comprehensive series of illustrations which would help to depict the lives of our already fast-changing native tribes'. Naturally she threw herself heart and soul into this project, and in the end the expensive expeditions required for the very difficult field-work were made possible by generous financial assistance, 'so that', she wrote, 'we are very fortunate in our friends'—one of the first to come forward being Mr. Robert McGregor, son of the founder of the Museum. Miss Wilman accompanied Mr. Cronin on the first two expeditions, and later selected and arranged the photographs for publication, chose the authors who wrote the Introductions according to their expert knowledge of the tribe to be dealt with, and undertook all the secretarial work, editing, and proof-reading connected with the entire production.

The Rock-Engravings of Griqualand West and Bechuanaland (Cambridge, 1933), Miss Wilman's *magnum opus*, is a stately royal 4to with seventy plates as well as text-figures and seventy-one pages of text, including the 'Historical Introduction' which gives a summary of the observations recorded by previous workers in this field from 'Robert Moffat, writing in the year 1842'. Interspersed with the more solid matter there are fascinating discussions, as in the section entitled 'Who were the Engravers?' (p. 52), to delight the merest novice and lead him on to further study of the Bushman-painters who 'were the true cave-dwellers' and the Bushman-sculptors who 'preferred the stony hills covered with boulders which they sculptured with their carvings'. The field-work, most of it perforce 'confined to week-ends' and often difficult and complicated, covered a period of twenty-four years, and 'could not have been carried out at all without the co-operation of a number of friends in the country districts, often the fortunate owners of the engraving-sites, who with the most delightful hospitality placed their homesteads, their conveyances, and their families often (for even the children have helped) at the writer's disposal'. (Lucky children to have had the privilege of associating with such a knowledgeable enthusiast as Miss Wilman!) 'Financial assistance for the field-work was rendered by the Royal Society of South Africa and the cost of publication . . . borne by the Carnegie Corporation of New York.'

The last of the publications to be issued from the McGregor Museum during her regime is M. Wilman's *Preliminary Check List of the Flowering Plants and Ferns of*

Griqualand West,* published in 1946—a royal 8vo containing 381 pages, and again a model of good production by the Cambridge University Press. Indeed, it is much more than a 'List'. Descriptive notes made from living plants supplement those in the *Flora Capensis*, and chapter and verse of this standard work are quoted for the description of each genus listed; localities, habitats, frequency and flowering season, as well as collectors' names and numbers, are given; and to complete the book there is a glossary of abbreviations and terms as used in Griqualand West together with a list of the common names of Griqualand West plants, and an index to the Families and Genera. A copy of the farm map made by J. P. H. Acocks, indicating all the collecting localities, is included in the volume. With all this correlated information the book now serves, and is likely to serve for many a long year, as an excellent guide to the flora of this large area, and provides an important contribution to the Botanical Survey of South Africa. Nothing of this nature in any form whatever dealing with Griqualand West had previously existed, and as a 'List' it is superior to all the other 'Lists' that have been compiled in South Africa. A more ambitious work had been planned with an 'historical introduction, notes on the physical geography, geology, meteorology' and much else of great interest, all familiar subjects to Miss Wilman which she could so readily and profitably have dealt with. But the high cost of publication made all this impossible at that time. In a letter to me referring to this work she wrote: 'I am glad you like the book. It has been a job, but I was fortunate in having E. E. here just when I most wanted help. As far as I am now concerned, I am afraid it will remain a Preliminary List. The war has wasted 6-7 of my years, and who is to carry on? If only E. E. were here! By the way, I put E. E.'s name on the title-page, and she objected. So I had to cable to Cambridge to take it off.'

To all these successful efforts there were two important sequels (surely as much *propter hoc* as *post hoc*) in which she must have heartily rejoiced. For eventually the whole of the Duggan-Cronin collection (portraits, implements, etc.) was acquired and became part of the Museum, but housed in a separate building lent by the De Beers Diamond Mining Company; and in 1956 another fine building was added to the Museum, chiefly to exhibit the larger animals. It stands opposite the original building, and besides the Exhibition-hall has a lecture-hall for school-children and a special room for the precious herbarium and further botanical work, both most valuable adjuncts. Again the support of the 'Clan McGregor' had been foremost, Mr. Robert McGregor donating the land and his sister's (Mrs. Helen Jessie Crawford) bequest providing half the cost of the building, the rest of which was generously borne by Sir Ernest Oppenheimer, the De Beer's Company, and other friends.

In 1939 the honorary degree of Doctor of Laws was conferred upon her by the University of the Witwatersrand. It was indeed a well-deserved honour and most fittingly bestowed in the north (where so much of her life-work was accomplished) and by a friend from the south, the late Hon. J. H. Hofmeyr, as Chancellor of the University.

* In the Preface to this work Miss Wilman wrote: 'The field work, of which this list is the outcome, has been in progress for the last thirty years. . . . As a result of this activity large quantities of plants were sent here (many of them for determination) and were preserved by us, but there existed here no further facilities for this work, nor, indeed, were we qualified for it. All plants had therefore to be sent to the Cape for identification, some of them to specialists. The bulk of this heavy labour (for so it has proved) was, however, cheerfully undertaken and has continued to be undertaken by Mrs. Louisa Bolus, Curator of the Bolus Herbarium, University of Cape Town, and her staff, without whose active co-operation this work could not even have been contemplated.' In return for this help the Bolus Herbarium received duplicates of nearly all the collections that were made. These have been incorporated and, being thus available for the use of local students as well as for institutions in South Africa and abroad requesting the loan of mounted sheets for special study, will therefore be represented in botanical literature. Miss Wilman knew the Herbarium in its earlier days at 'Sherwood' which was quite near 'Thornton House', her Kenilworth home. She maintained her loyalty to the Herbarium by sending us plants to within two years of her death.

The ruling passions of Miss Wilman's life were her devotion to work, combined with a strong sense of duty, and her love of beauty. They seemed to inspire and nourish each other; for beauty stimulated the urge to work and this unflinchingly produced a thing of beauty. As an ardent gardener there was ample scope for the exercise of both. First the little garden in the Museum grounds was planted to provide the cut-flowers which she always arranged with loving care herself in the Museum, so that where there was much to instruct and edify, there should also be loveliness to satisfy the pleasure-loving instincts of man and give delight. Then she planted and had charge of the famous rock-garden about 1,330 feet in length and extending along one boundary of the Public Gardens—a gorgeous sight when the Aloes were in full bloom. Besides the succulents and other small plants there were a variety of native trees, shrubs and a large number of treasured species of grass. Was there ever such a rockery before in South Africa? Two 'afternoons' were set aside for work on it; but she carried on long after all the other workers had left, unable to tear herself away and heedless of time and of the chauffeur-assistant, anxious to get her safely home and on pins and needles lest the uncertain little Austin, getting colder and colder, should refuse to start. Another part of the Public Gardens reserved for the non-succulent South African plants was also in her charge. Here among the more sturdy plants, many useful to farmers as food for their stock, the Namaqualand annuals could display their beauty in the late winter and spring. It was due to her influence also that the native Karrees (*Rhus viminalis* and *R. lancea*), the two Mesquites and the Australian drought-resisting Kurrajong, were grown in the streets of Kimberley to replace the old 'Peppers'. The Kurrajong (*Sterculia diversifolia*) was introduced by De Beers from Queensland, where they are called 'Food Trees', the foliage being palatable and the seeds (eaten by horses) full of oil like those of the most famous *Sterculia* (*S. cacao*) from Tropical America. It is interesting to note that we have a native *Sterculia*-tree (*S. alexandri*) growing in the Eastern Province. One of the two Mesquites (*Leguminosae*) grown in Kimberley, *Prosopis alba*, has sweet pods much beloved by Native children during the sugar-shortage. But perhaps the most important of Miss Wilman's public-spirited activities was the collection and distribution of great quantities of grass-seed both for pasturage and soil restoration. The two species that proved most satisfactory were *Eragrostis lehmanniana* and *E. curvula*, the former now called 'Arizona Wonder Grass'. 'I have been interesting myself in the roots', she wrote, 'because it seems such a wonder the way our grasses pull through the drought and recover the moment there is even a drop of rain. Of course the red soil, besides being crumbly, is very rich. There is enough grass-seed in this area now to sow the whole of S. Africa, etc. Our grasses have gone to Mexico, then S. America and St. Helena—in fact they are putting a girdle round the earth.' Referring later to an honour received from America, her comment was: 'I am more interested in having helped to fill a dust-bowl in U.S.A. with *Eragrostis curvula*.'

It was indeed a crowded and varied life—now entertaining eminent scientists, now 'minding the Museum' (while the Assistant might be absent) and having it kept spick and span and polished. Sometimes 'it was almost overwhelmingly popular and making a lot of work for us. School children we always have; then soldiers and airmen; but just now we have marines and sailors, and right glad we are to see them.' From the beginning she had mounted the dried botanical specimens, and then had reserved this lowly duty for herself throughout, because 'It does not do for two people to be at the same job.' The Herbarium, as she left it, comprised about seven thousand sheets.

Of course there were always perplexities, difficulties and perversities of will to struggle against. But she had been well disciplined in her youth ('My eldest sister from the time she was seventeen ruled us all with a rod of iron'), and she knew the world was not a comfortable, cosy place where what was worth having could be got without a sacrifice of some sort, and so she faced them all courageously and achieved

much. Yet what had been accomplished fell so far short of her ideals that she was never satisfied, and almost shrank from praise in any form; it was help she craved, and more help, from her friends and sympathizers to fulfil *more* of her bold designs. Only in the vast wild spaces, when the rains had come and the 'sweet buds' were driven 'like flocks to feed in air' and fill 'with living hues and odours plain and hill', was her soul triumphant and joyous in the

'Great, wide, beautiful, wonderful World,
With the wonderful water round you curled,
*And the wonderful grass upon your breast—
World, you are beautifully drest.*

(The italics are ours.)

And she could join heartily in the loftier strains of the *Venite*, enriching, as a scientist, with a fuller meaning than the Psalmist knew, some of its words, such as those italicized in the verse: 'The sea is his and he *made* it: and his hands *prepared* the dry land.' Then she heard the voice 'that inspired her to work and serve—which is love at its greatest'.

Friends played a great part in Miss Wilman's life, and she had many whose troubles she shared, and some to whom she was a friend indeed, or even a fairy god-mother, as her eldest sister's grand-daughter could tell. After a spell of leave at the Cape in 1942 she wrote to us: 'I am so glad you enjoyed my visits; the pleasure was reciprocal! You know, the old Cape friends are becoming fewer and fewer; so we must the more cherish them. . . . Fortunately I always liked people of all ages, so am now not so badly off as some of my contemporaries. And I have numbers of *quite* young friends.' She was an easy speaker and letter-writer, with no waste of words in either capacity, in spite of her flair for accurate details. Her letters, usually dashed off at top speed, gave vivid descriptions of scenes, events and people. Sometimes delicious little bits (which seemed to bring her very near) would be irrelevantly slipped in—'wonderful soft rains, a true *renaissance*. Fragrant the fruitful earth after soft showers'—and often there were sprightly endings like the following: 'We have heaps of water now, for the Vaal-Harts scheme is well established; and when Vaal water fails us, we may bathe in the waters of the Harts—at the cost to the taxpayers of £1,000,000. You are one of them—so "Thank you! Madam." ' She had written of the drought and the settlers at the Vaal-Harts, suffocated with dust, whose 'plight must be unendurable, although they have *water*; since all the veld was stripped bare of tree and bush before they were set to produce a Paradise'. Later she wrote, 'Having cleared off the soil cover they are now planting *poplars* to break the wind!' Another extract (dated January 6, 1940) shows how much she could convey in a few words, and also how firmly she could deal with an awkward episode. 'I am glad you liked the book [*Bantu Tribes*]. Mr. Cronin has just been going for me "Because you happen to have finished your education [*sic*] at Cambridge my books have been published there. Had the photographs been decently reproduced, elsewhere, the books would have sold, not have hung fire, as they have." Explosion!!! I have told him to find another publisher, and editor. This is by the way.' And she was soon on the road again, discussing matters of more vital importance to her bairn, the 'Wee McGregor'. Her sense of humour made her 'suffer fools' more gladly than she might otherwise have done. She often called herself one, sometimes with an adjective for emphasis, and, as likely as not, some of her acid or caustic remarks might likewise on occasions have been aimed at herself. But there is no doubt that she fully sympathized with the poet who wrote:

'What had I on earth to do
With the slothful, with the mawkish, the unmanly?
Like the aimless, helpless, hopeless did I drivell . . . ?

Miss Wilman was always faultlessly, and elegantly, dressed for all occasions with an almost puritanical avoidance of surplus ornament and artificial aids to beauty, yet with no suggestion whatever of the mythical 'blue stocking'. Alert in mind and body, but calm and quiet in manner and speech, even when her feelings were roused, she seemed ageless. But the war had left her very tired and feeling the weight of her 'heaped-up years'. In May 1945, after warmly inviting me to visit her, she continued: 'Mind, I expect it. You know I am getting desperately old; so my friends must take my requests seriously.' (She was also doing her best to give one of them a holiday.) Towards the end of 1946 she wrote: 'I have never thanked you for your handsome testimonial—greatly appreciated by me. But, no, my laurels do not weigh heavy upon me . . . now when I am a bit of a wreck (*but my people must not know it*) I am having to put up a stiff fight for the best and oldest part of our garden. . . . Kimberley says "if Johannesburg could not save the Wanderers, how can we hope to save our garden?" (You see what a wreck I am.)' This trouble was caused by the threat (afterwards withdrawn, no doubt largely owing to her vigorous protests) of the Railway Department to include a considerable part of the garden in a recreation ground for their employees. If only she could have got more often to 'the edge of the Kaap Plateau to overlook the rest of the world—and one sees so far here in this clear air', she would have had more strength to bear the blow. 'But I cannot get about as Mr. Cronin is ill in hospital and I have another old friend there as well.' In the midst of all this distress she decided to resign her post as Director of the Museum, 'severing my connection with the Board (tho' not with the Museum which I shall always serve) at the end of 1946'. She was more her old self in June 1951 when she wrote: 'The cold is bitter—no snow, the air is too dry! I wish I were standing on the top of the Zwartberg Pass. I believe I could still *foot it*! Believe it or not!' (She liked to think of this Pass, a feat of engineering skill and sublimely beautiful, as being a memorial to her father, who introduced the Bill for its construction and, although strongly opposed, steered it successfully through Parliament in 1880, Parliament voting £12,000 and the Divisional Council an equal amount.)

In the latter part of 1953 Miss Wilman was so unfortunate as to break a thigh-bone—a sad mishap and a great shock at her advanced age, which affected her mentally as well as physically. After several months in hospital the devoted sister who was in attendance on her there brought her to George. There, partly with her sister and partly in the Palloti Home, she remained until her death on November 9, 1957. From her bedroom window at the Home there was a beautiful view of the George mountains which delighted her, and it may be that joy in 'the strength of the hills' was, mercifully, hers also to the end.

Among those of her botanical discoveries that bear her name may be mentioned *Watsonia wilmaniae*, *Stapelia wilmaniae*, *Ruschia wilmaniae*, *Hereroa wilmaniae* and *Nananthus wilmaniae*.

Miss Wilman became a Member of the South African Philosophical Society in 1898 and was at the time of her death a Life Member of the Royal Society of South Africa.

Grateful acknowledgement is made of the help received from the National Council of Women in a memorandum submitted by the late Mrs. Ina C. Abbot (née McGregor), from the University of the Witwatersrand and from the McGregor Museum.

H. M. L. B.

PRESIDENTIAL ADDRESS

REMINISCENCES OF CHEMISTRY AND PHYSICS TEACHING OVER SIXTY YEARS

BY E. NEWBERY

(Read March 19, 1958)

My first experience of Chemistry teaching was in 1891 when I had attained the mature age of 8 years. This was at the Grammar School in Presteign, Radnorshire, where my father was Headmaster. On Wednesday afternoons, from 2 to 3 o'clock, we studied chemistry from Roscoe's *Elementary Chemistry*, a small brown book of about 100 pages. A section of the book was allotted to be read up, and towards the end of the period we had to answer questions, sometimes by writing the answers on our slates, but more often by word of mouth. The school was a small one with only about thirty boys aged 8 to 16, and it was very unusual to find any science taught in a school of that size. Very occasionally an experiment was shown, and if this experiment produced anything in the nature of a bang, that was a red-letter day to be discussed in great detail for weeks subsequently. In course of time, I developed my own 'Lab' in a disused attic over an outbuilding, with one test-tube, one bent glass tube about 8 inches long, a spirit lamp made with an old penholder pushed through a cork in a gum-bottle, with a wick of twisted string, and many other oddments picked up from rubbish heaps. Since my financial assets ran to 1d. per week, it is rather surprising how many experiments, official and otherwise, were carried out, and even now I have not lost my respect for 'simple' apparatus.

In 1898 I went to Birmingham, to a private school at Harborne, and attended a chemistry class at the Municipal Technical School in Suffolk Street on Wednesday afternoons, to prepare for the London Matriculation examination. I still have vivid memories of my delight at handling 'real' chemical apparatus, previously known only from book illustrations. In November of the same year, the laboratory assistant in the Inorganic department resigned, and I was offered and joyfully accepted the vacant post at the munificent salary of 8s. per week. The working hours were 10 a.m. to 1 p.m. and 6.30 to 10 p.m. except on Wednesdays and on Saturdays, when they were 10 a.m. to 10 p.m. and 10 a.m. to 1 p.m. respectively, with fourteen days' holiday per annum. Studying for Matriculation was done in the afternoons, and I managed to pass the examination in June of the following year. The Chemistry paper seemed very easy, but very few candidates took it at that time.

The chemistry courses were mainly in preparation for the South Kensington certificates (later changed to Board of Education), but special classes were run for

'Chemists and Druggists' and for 'Bakers and Brewers'. There was also a 'Day School' for boys, but I was not concerned with that.

There was only one laboratory, a large room divided into two parts by a balance room and a combustion room. About two-thirds formed the inorganic laboratory and one-third the organic laboratory. Each long bench had a small fume cupboard in the middle with rising glass slides on each side. These will be referred to later.

Elementary inorganic chemistry dealt with the non-metallic elements and their compounds, and the advanced course with the commoner metals and their compounds. All these substances were dealt with in the order: (1) Occurrence, (2) Preparation, (3) Properties.

The first of these usually involved the exhibition of various mineral specimens on the lecture table, and I had the pleasant task of selecting these specimens from a very good collection belonging to the Head of the Department, Mr. C. J. Woodward, who not only encouraged my early interest in mineralogy, but also gave me a large number of the specimens when he retired in 1902. These formed the beginning of the collection now in the University of Cape Town Geology Department.

Very little physical chemistry was taught at that time, and comparatively few chemists then realized its importance. The Brunner Chair of Physical Chemistry at Liverpool, founded in 1903, appears to have been the first of its kind in Britain.

The practical work in the elementary course consisted mainly of the preparation and study of the properties of the bodies described in the lectures. In the advanced class, qualitative analysis of mixtures of metallic salts and simple quantitative analysis occupied most of the course. Blowpipe and flame tests were given much greater prominence than is customary nowadays.

The attitude of the average British citizen towards science at that time is difficult for the present generation to understand. Ignorance of the most elementary and fundamental scientific facts was profound, and John Bull not only did not know them, but did not *want* to know them. 'I'm a *practical* man, I am, and haven't any time for your theories' was a typical reply to any suggestion to a scientific approach to a problem.*

A boy in the day school, during a practical class in the inorganic laboratory, turned the gas on in one of the bench fume-cupboards previously mentioned. After a suitable time, another boy on the opposite side of the bench lifted the slide a little and pushed a lighted taper in. They were both in hospital for a fortnight, but the *Birmingham Daily Post* came out with the headline 'Explosion of a Bunsen Burner' and nobody appeared to see anything wrong with the account.

A baker attending the special 'Chemistry for Bakers and Brewers' class was greatly intrigued on hearing that alcohol was formed during the preparation of his bread,

*Perhaps this attitude was partially due to controversy and uncertainty among the scientists themselves on theories which are now looked upon as fundamental. For example, the reality of atoms and molecules was by no means accepted by all scientists, and even as late as 1907, Ostwald referred to 'The unnecessary Atomic Hypothesis'. Also, the attempts (especially numerous about that time) that were being made to reconcile geological discoveries with biblical accounts of the Creation and the Deluge served still further to foster scepticism in unscientific minds. To many people, science and atheism were so closely allied that they appeared inseparable.

and he rigged up a condenser in his oven and managed to collect a small quantity which he proudly exhibited in his window, with the result that his daily sales increased considerably. A rival baker began to feel the pinch, and retaliated with a big notice that all *his* bread was sold 'With all the Gin in it'.

When rowing a punt on the river at the bottom of our garden, a gardener on the opposite side of the river asked me to take him aboard in order to cut away a mass of water-weed. After the job was done, he attempted to pull the boat to land by standing on one of the seats in the boat and pulling another seat with a long-handled hedge-hook. He refused to believe me when I pointed out that he was not helping, and actually tore up the seat in question. To such a man, Baron Munchausen's tale of how he saved himself from drowning by lifting himself out of the water by his own hair would appear quite credible.

My landlady in Birmingham, a retired farmer's wife, aged about fifty, maintained that boiling point was 212°F ., and that *everything* boiled at that temperature. She refused to listen to any evidence to the contrary. However, the same woman, who had been a cheese-maker in Cheshire, expressed the opinion that a fortune awaited the man who could find a way to measure the 'quantity of acid in cheese'. 'You can find whether it is acid or not with *litmus* paper, but that doesn't tell you how much acid there is.' pH had not been invented at that time, and it was many years later that I realized that therein lay the answer to her problem.

At my home in mid-Wales, a tale was current that a witch had prophesied that some day, coal would be found there, and Presteign would become a very wealthy town. Relying on this, a syndicate was formed, and boring started in typical Silurian rock. Later, a drift was cut into a hill near a fault between Old Red Sandstone and Silurian formations, and I obtained some good specimens of Trilobites (*Longicaudata*) which are now in the Manchester Museum. A specimen of 'coal' from the bottom of this drift was shown to me, and proved to be quartz crystals coated with black iron oxide. I became very unpopular when I suggested that a balloon would have a better chance of finding coal than a shovel.

It is not surprising, therefore, that scientists in England at that time were very poorly paid, and only those with a real love for the work were willing to face up to all the discouragements of such a profession. Small wonder also that so many scientific discoveries made in England were exploited in Germany and elsewhere, giving the false impression that German chemists were much better than English.

After the 1914-18 war had been in progress for some time, a member of the British Parliament produced quite a sensation when he announced in the House that he had been reliably informed that glycerine was used for making explosives. Up to that time, both glycerine and cotton were not included in the 'Contraband of War' list.

Shortly before the War, the Military College at Sandhurst had deleted science from the list of requirements for a commissioned officer, though Latin and Greek were still compulsory. In striking contrast with this, it may be noted that in 1955, Britain spent £315 million on scientific research, of which £16 million was allotted to universities and technical colleges.

This attitude received a severe shock when the Germans launched the first gas attack at Loos during the First World War. The change in the attitude of the general British public towards scientists was almost incredible. From being an almost unknown nobody, the chemist was exalted into the position of a little tin god, and for the first time the man in the street realized that chemistry could vitally affect him personally.

In 1917, the directors of a 'chemical' firm who had made small fortunes in deals with the Government decided that they would be more up to date if they had a real chemist on their staff, and approached a recently qualified research M.Sc. in Manchester University, offering the princely salary of £100 per annum. They were rather taken aback when the offer was declined by the student who explained that a 'Research' chemist expected considerably higher remuneration. They then became confidential and explained that they really had no need of such a highly qualified person to do research. 'If you took a job with X [a rival firm] for six months and found out how they did things, and then came to us, that is what we would call *research*'!!

About the same time, Dr. Pomilio (who installed the first electrolytic chlorine plant in South Africa at Springs, for South African Paper and Pulp Company, worked out a process for preparing sodium salicylate by electrolytic oxidation of ortho-cresol in fused NaOH, and patented the process. Another 'chemical' firm approached him for a licence to use this process. Pomilio, suspecting that they had no idea what they were in for, asked if they could secure sufficient electric power to run the plant (about 1,000 kw. minimum), and was informed, 'Oh, yes, we have electric light in the building.'

In 1903 I went to Uppingham, one of the well-known public schools of England, in Rutland. Here, as a junior science master, my salary was £100 to £120, just double my highest salary at the Technical School in Birmingham. My main work was teaching elementary physics, but I also had a workshop where I was able to make most of the apparatus required. This school was then much in advance of the times inasmuch as the pupils who took the 'Modern' studies were less looked down upon by the 'Classical' side than was customary at the other large public schools.

The boys received a thorough grounding in theoretical and practical physics for at least a year before beginning chemistry. The properties of matter, gas laws, heat, light, and electricity and magnetism were dealt with, and subsequent progress in chemistry was found to be much more rapid than had been possible before this scheme was adopted.

While teaching at this school, I managed to pass the London B.Sc. examination, second class only.

In 1907 I went to Sidcot, a Quaker co-educational school on the Mendip Hills in Somerset, where I spent five very happy years as resident science and mathematics master. Here the heuristic system was used, and most of the senior staff had Diplomas in Education. The Headmaster was Bevan Lean, D.Sc. (Manchester), a man with a vigorous and forceful personality, eminently suited to his position. There were about 200 pupils, nearly all resident, and boys slightly outnumbered girls.

Elementary general science was started in the lower school, the upper Third form, and physics with some elementary chemical topics in the lower and upper Fourth form, leading on to chemistry proper in the Fifth and Sixth forms. Atomic theory and chemical symbols were not mentioned till the lower Fifth form was reached.

In order to prevent the pupils starting a new subject with preconceived ideas, their textbooks were taken away before that subject was introduced.

In the laboratory classroom, the benches all faced the lecture-table and blackboard, and at the beginning of each class a short statement of the object of the work was given, together with a demonstration of the methods of handling any apparatus new to the pupils. They were then told to go ahead and find out the fundamental laws for themselves. When the work (which might occupy several sessions) was completed, and their conclusions written up and handed in, the textbooks were returned. The excitement when a pupil found that his or her conclusions were exactly confirmed by the textbook was intense. Questions asked by the pupil during the work were usually parried by the master asking the pupil leading questions with the object of showing him or her how the answer could be obtained by reasoning from facts already known. Mathematics was taught on similar lines. Progress at first was naturally very slow but very sound, and became much more rapid in the higher classes.

No attempt was made to 'cram' for examinations, and 'spotting' of questions was unheard of, but nevertheless, the examination results obtained were spectacular. In one year, out of 54 entries for Junior and Senior Cambridge and London Matriculation exams, there were 53 passes with a plentiful proportion of first classes and distinctions. In addition to this, a remarkable affection for the school was induced in the pupils, though how far this was due to the system of teaching is a matter for speculation. The Old Scholars Association, which now numbers about 1,500, has been responsible for a considerable proportion of the present buildings, including the science laboratories, swimming-bath, gymnasium, and sports pavilion.

Facilities for persons of small means to get to a university at that time were far less than at present, but by 1912 I had saved enough to enable me to go to Manchester University to carry out research work for a higher degree. I left that school with great reluctance, a confirmed believer in heuristic teaching. My first two years at Manchester were devoted more to learning than to teaching, though I did coaching in mathematics five evenings per week to help pay my fees at the University Hostel, Dalton Hall.

I soon found that the heuristic system required considerable modification when dealing with older students who had received their elementary training by other methods. Nevertheless, I persisted in using the fundamental principles of this method both in Manchester and Cape Town, especially in practical classes. At first the method is certainly unpopular with the average student, but the process of compelling the student to think out things for himself pays dividends in the long run, and most students appreciate this in the higher classes.

At the end of these two years, I found myself with the desired M.Sc. degree, and with my financial resources exhausted, but then Sir Ernest (later Lord) Rutherford offered me a Research Fellowship, which, together with coaching fees, enabled me

to carry on with the study of overvoltage phenomena in the Electro-chemistry Department which formed part of the Physics building. The First World War had then begun, and I joined the O.T.C. with a view to applying for a commission. Before I could do this, the lecturer in charge of the department, Dr. Pring, obtained a commission and left me to carry on his work. Then war problems of all kinds came pouring in, from Government departments and from firms engaged in Government work, in such volume that I had quite a guilty feeling when I managed to squeeze in a bit of overvoltage work. When I attempted to apply for a commission, I was bluntly informed that I would not be allowed to leave the work I was doing, and I therefore resigned from the O.T.C.

The teaching work at that time involved one class in General Electro-chemistry and one in Applied Electro-chemistry, each class receiving two lectures per week, with one full day per week for the practical work in the Applied class only.

In addition to this, all the practical work in Physical Chemistry (including that for General Electro-chemistry) for the whole three-year honours chemistry course was crowded into two spells of a fortnight each in the first two terms of a three-term year. The students came over in batches of ten to twelve at a time to spend five days per week (less time off for lectures) doing practical physical and electro-chemical work. It must be remembered that Manchester at that time was primarily an *Organic* Chemistry centre, and it was quite normal for a third-year student to spend 48 hours per week in the Organic Laboratory when working for an Honours degree.

Although I put up the most comprehensive and intensive course I could devise, I felt more and more that the best I could give the students under these conditions was out of all proportion to the rapidly growing importance of the subject, and towards the end of my stay in Manchester, I mentioned my difficulties to Lord Rutherford. He took the matter up with his usual vigour and informed the Science Faculty (of which I was not a member) that the whole system required drastic reformation. The result of this is seen at the present day in the form of a complete new block of buildings, with full Professor and staff, devoted entirely to Physical Chemistry.

When I arrived in Cape Town in 1919, the two-course system was in use for the ordinary B.A. degree. Science students were bound to take one language course (usually Latin) and one philosophical subject (usually Ethics and Politics due to timetable difficulties), and there were no science degrees given. The M.A. degree could be obtained with one year's further study without doing any research work, and was therefore of lower standard than the Manchester M.Sc. degree.

I did not like this and frequently said so in Faculty and Senate, but it was not until 1933 that the B.Sc. degree was introduced along with three-course science subjects, and the compulsory philosophical subject dropped. Still later, some research work was included in the requirements for the M.Sc. degree.

A difficulty which was not finally removed until after my retirement from the Chair of Physical Chemistry was the standard of mathematics required from chemistry students. Although one course in pure physics was demanded before a student was admitted to the third course in chemistry, a corresponding course in pure mathematics

was not required. It was therefore necessary in this course to cut the chemical thermodynamics to the barest minimum for the benefit of the non-mathematical students—a very undesirable proceeding. We were later empowered to refuse permission to non-mathematical students to enrol for the M.Sc. course in chemistry, and an intensive section on chemical thermo-dynamics formed an important part of the fourth-year physical chemistry course. These regulations have now been changed, and a considerable proportion of the essential thermo-dynamics has been transferred to the third course, giving a much better balanced system.

With regard to Electro-chemistry, before my arrival in Cape Town, the fourth-year Electrical Engineering students were given a course in elementary theoretical electro-chemistry which appeared somewhat unsuited to advanced students. It was therefore changed to a course in Applied Electro-chemistry with the hope that these students would be in a position to foster the growth of electro-chemical industries in South Africa, then in a deplorably backward condition. Unfortunately, these efforts to arouse an interest in electro-chemical methods in industry bore little fruit for many years. A few electric furnaces for steel-making and heat treatment were installed, and later on some attempt was made to produce ferro-alloys in the country, in place of the wasteful proceeding of exporting raw ores and then buying it back again in the form of ferro-alloy. No firm could be persuaded to take up the manufacture of chlorine and caustic soda from common salt in spite of the presence of abundant raw material, cheap electric power, and an assured market for the products: bleaching powder, water treatment, soap-making, and others.

About 1937, Dr. U. Pomilio, previously referred to, installed an electrolytic chlorine plant at Springs for the South African Paper and Pulp Company, and this had barely started producing when the Second World War began. The whole country was dependent upon this one plant for water and sewage treatment, hygienic purposes in gold-mines, railways, etc., for the whole period of the war. Three different firms approached me with urgent requests for instructions as to how to construct a similar plant, but they had to be informed that they had missed their opportunities, and suitable plant was unobtainable.

Near the end of the war, the Government erected a plant consisting of Nelson Cells (also used by the U.S.A. Government) but the war ended before it was brought into production, and it is now used for the manufacture of DDT and other insecticides.

When the degree of B.Sc. in Applied and Industrial Chemistry was introduced, Applied Electro-chemistry was included in the requirements for this degree. About the same time, a course in Telegraphy and Telephony was offered as an alternative to Applied Electro-chemistry for the final-year Electrical Engineers, and the number of these students taking the latter course diminished as the number of Applied Chemists increased. The course was modified to include rather more pure chemistry, but the whole subject was developing so rapidly that no less than five changes of textbook were necessary in twenty years in order to keep the work up to date.

Financial affairs illustrate in a striking manner the gradual change of opinion as to the desirability of supporting both research and student's laboratory work. The Physical Chemistry laboratory in Cape Town, intended for temporary use only (ten

years) was fitted as cheaply as possible with plain deal benches and cupboards, and a sum of £50 per annum was allowed for running it. Students paid only for breakages of apparatus in their lockers, and all chemicals and other requirements were paid for out of the £50. No funds for research were provided, but I received a grant of £150 for the purchase of some standard instruments before leaving England.

One part-time cleaner was shared with the Engineering Department. Development of the department would have been difficult, and research work greatly hindered under these conditions if it had not been for the workshop in the department. The cheapest suitable chemicals were used for students' work, and even these were often recovered after use. More than half of the students' apparatus was home-made, and though somewhat crude in appearance, could give quite good results since in many cases accuracy could be checked with the aid of the standards previously mentioned. Most of the £50 was spent on raw materials—brass, steel, scrap timber, etc.—and a whole car-load of old electrical junk was bought from the Naval Dockyard at Simonstown for £1. Some of the apparatus thus made is still in use after thirty years.

Although the conditions for appointment to a University Chair contained a clause stating that the person appointed would be expected to carry on research, very little encouragement for research was provided.

About 1925 I badly needed a special type of low-voltage cathode ray oscillograph tube which then could only be obtained from America at a cost of £40. No money for this could be obtained from the University or from any Government funds, and after trying for two years to make one, without success, I applied to the Royal Society in England and got it at once. Incidentally a far better instrument can now be bought for £6. When the University moved to the present site, a substantial grant was made for new equipment, and a Staff Research Fund started which rapidly grew in amount and scope. About the same time, a Government Research Fund was instituted, which is now administered by the South African Council for Scientific and Industrial Research. The cost of some single pieces of apparatus now in the Physical Chemistry Department would have swallowed the whole of my maintenance grant for ten years.

SUMMARY AND CONCLUSIONS

At this stage I must apologize for the very personal nature of this address and the far too frequent use of personal pronouns. The main object in view has been to show, from personal experience, how greatly the appreciation of the value of scientific knowledge, Chemistry and Physics in particular, has developed during the last sixty years, not only in the average citizen, but also in the highest educational and industrial circles.

This development started in England in the seventeenth century but was painfully slow until the First World War. In Germany it began later but industrialists in that country were much quicker to realize the commercial possibilities of scientific discoveries. In America it began at least 100 years later, but proceeded far more rapidly, whereas in Russia, the speed of development during the last twenty-five years has

been phenomenal. In this country, the supply of trained scientists cannot keep pace with the demand, and measures to remedy this are now being sought, whereas thirty years ago, the few turned out by the universities had some difficulty in finding posts at less than half present-day salaries.

Many factors have contributed to this development of scientific interest: the British Association for the Advancement of Science with its South African counterpart, the S.A.A.A.S., scientific articles in newspapers, more and better science teaching in schools, and, last but not least, the impact of science upon commerce. When the business man realizes that science, or the lack of it, is affecting his profits, he usually wakes up in a hurry, and the present demand for scientists in industry with tempting financial inducements has led to a serious shortage of science teachers in schools and universities. The salaries offered to teachers are too often much less than those offered to their pupils with no experience. It would be well if both industrialists and governments would realize the apparently obvious fact that without an adequate supply of science teachers, they cannot obtain an adequate supply of trained scientists, and act accordingly.

A further cause of the present shortage of scientists, not generally recognized, is due to the action of some employers who have discovered that a scientific training frequently prepares a man very efficiently for filling the higher-paid administrative posts where his scientific knowledge is but little used, and a promising scientific career comes to a premature end. Only a very strong-minded scientist, very much in love with his subject, can resist the offer of such 'promotion', and the loss to the country as a whole (assuming State-aided university training) is serious. In such cases, it seems reasonable that either the employer or the scientist should refund part at least of the State's expenditure, but it would be extremely difficult to formulate legislation to effect this.*

The whole question of this shortage of scientists, and especially of science teachers, is complex and many-sided, and the financial aspect, though important, is only one of many. Scientific education must begin early in life, and yet too early specialization may produce that public danger—the uneducated scientist—that is, one who is so wrapped up in his own corner of science that he has no time to play his part as a useful member of the community in which he lives.

The remedy for this lies largely in the hands of the scientist himself, though his teachers, especially in the schools, can assist materially. Outside interests such as music, literature, social service, sport, and others should be encouraged, and some acquaintance with other sciences, whether allied or not, is essential. In this respect, membership of a learned society, such as our own Royal Society, which caters for a whole group of sciences, can be of inestimable value, especially if the scientist makes a practice of attending and endeavouring to understand lectures and papers on sciences other than his own.

*Some industrial posts are occupied by men with academic qualifications far in excess of those required for the work to be done, although the remuneration may be quite generous. In such a case, if the scientist does not speedily find a new post, mental atrophy occurs only too soon. Technicians, and not fully trained scientists, should be chosen for such posts.

Again, the science teacher requires somewhat different training from the industrial scientist. Many eminent scientists find difficulty in communicating their knowledge to students, especially in the junior classes. This is most marked in mathematical subjects, but such men can still be of the greatest value if suitable posts can be found for them. South African universities badly need more Chairs where the occupant is required to do no teaching other than a few lectures to selected post-graduate students, his duties to consist of his own research work together with the guidance of a team of research students in a department specially equipped for such work. Unfortunately the ability to teach a subject cannot be inferred from academic degrees and other qualifications, and even the possessor of a high degree in education may be lacking in this respect. Where it is found, some financial recognition should be forthcoming, but it is difficult to visualize any satisfactory scheme which would effect this without provoking endless jealousies and accusations of favouritism.

In conclusion, reverting again to the main object of this address, it would be well if teachers would impress upon the younger generation the immense advantages they now enjoy in the form of facilities for scientific study and its rewards, both materially and mentally, compared with the state of affairs fifty years ago, while still stressing the fact that such rewards can only be attained by steady and persistent hard work. At the same time one may ask the question: Is this new appraisal of the value of science going too far? Are we in danger of exalting science almost to an object of worship? Science can be immensely powerful for good, but misdirected science can be equally powerful for evil.

The worship of 'Reason' in Napoleonic times ended in disaster. In Russia and possibly in other parts of the world there appears to be a tendency to regard 'Science' in a similar light, while the eternal spiritual values are ignored or depreciated. The man imbued with the true scientific spirit—love of truth for its own sake—cannot help being intensely humble-minded, for he recognizes only too well the vast difference between the little scraps of knowledge he has acquired by lifelong study and the infinite amount still unknown to him. Happy is that scientist who never loses a child-like sense of wonder, and reverence for the Creator of all these wonders, as new vistas of scientific truths open out before him.

THE FAMILIES POLYCERIDAE AND GONIODORIDIDAE (MOLLUSCA,
NUDIBRANCHIATA) IN SOUTHERN AFRICA

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(With 23 text-figures, and Plates XVII-XVIII)

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In this paper descriptions are given of thirteen species, of which five have already been described from southern Africa. Ten of them belong to the family Polyceridae and three to the Goniodorididae.

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Family POLYCERIDAE

This family-group name was first used by Alder and Hancock (1855) to include all those Doridacean genera which have non-retractile gills. Bergh (1880-3) used the spelling Polyceradae, and separated the Goniodorididae from the group as established by Alder and Hancock. Vayssière (1901) used the name with same spelling and scope as Bergh had given to it. Eliot (1903) suggested that the Polyceradae of Bergh should be divided into the Polyceridae with limaciform bodies and the Pseudodorididae which are flat and dorid-like. Later in 1910 he further subdivided the Polyceridae by separating off certain marginal forms as the Notodorididae and defined the Polyceridae in its now restricted sense as those genera with

'branchiae forming a tuft, but not retractile into a pocket. Two spermatothecae. Shape generally limaciform with appendages. Teeth differentiated. Radula often narrow.' Iredale and O'Donoghue (1923) and O'Donoghue (1929) substituted the name Euphuridae but retained the scope of the family. Thiele (1931) gave the family a wide comprehensiveness, almost as wide as the original family-group set up by Alder and Hancock. He divided the family into four subfamilies, the Noto-doridinae, the Polycerinae, the Onchidoridinae (or Pseudodoridinae) and the Goniodoridinae. I agree with Odhner (1941) that this use is unwieldy and prefer that established by Eliot in which each of these groups is given familial status. As used by Eliot the family Polyceridae comprises several genera which fall readily into three subfamilies:

- (i) the Triophinae which includes the genera possessing ramose or compound processes;
- (ii) the Polycerinae with those genera having simple papillae on the frontal and mantle margins; and
- (iii) the Gymnodoridinae of which the genera have no mantle processes and only a rudiment of the mantle itself.

Odhner (1941) considered that each of these groups should be elevated to families, but this is unnecessary for the differences between the groups are slight and the resemblances too great to permit of separation.

Even when one takes into account the great diversity of ornamentation by papillae and arborescences, and their complete absence, there is a considerable similarity in the external facies. This similarity is also shown in organization.

The principal ganglia are concentrated into a compact mass above and along-side the oesophagus, with only commissures passing below it. The pleural and cerebral ganglia are usually enclosed in the same sheath and are not easily distinguishable when viewed from above. The abdominal ganglion is drawn up so as to lie close to the pleural ganglion on the right side. This arrangement is constant throughout the family with only slight variations. All species examined also showed a blood gland in association with the anterior aorta, and lying in the mass of connective tissue overlying the posterior portion of the anterior genital mass.

The post-pharyngeal regions of the alimentary canal appear to have a similar arrangement in all genera examined, but the buccal region and its armature affords useful diagnostic characters. There is a cuticular lining throughout this cavity in the subfamily Gymnodoridinae, and this is most strongly developed in the new genus *Lecithophorus*. The labial portion of this lining may be thickened. Jaws are absent in most genera but present in *Polycera*, *Thecacera* and a few others, not found in South Africa. The form of the radula and its teeth are diagnostic. The radula may be very wide as in *Gymnodoris*, of moderate width as in *Limacia*, and *Kaloplocamus*, narrow as in the majority of genera or absent as in *Lecithophorus*. The teeth have a variety of shapes, the laterals of all genera appear to be a modification of a hamate form. A rachidial series is present in a few genera only.

The gonad may be distinct and separable from the diverticula of the digestive gland, as in *Gymnodoris*, or its follicles may be so intertwined with the diverticula as to be inseparable from it, as is the case in the majority of genera. The anterior genital mass has a similar lay-out in all genera and species but generic and specific differences occur in the extent of development of the prostatic portion of the vas deferens: in the arrangement of the ducts leading to and from the spermatheca and spermatocyst: in the form and size of the ampulla of the hermaphrodite duct: and in the form, size and armature of the penis. Reference to the descriptions which follow will illustrate these points.

The genera recorded from Southern Africa may be distinguished as follows:

- | | |
|--|----------------------|
| 1. Mantle processes compound | 2. |
| Mantle processes simple | 4. |
| Mantle reduced, no processes | 6. |
| 2. Mantle edge with arborescences | <i>Kaloplocamus</i> |
| Mantle edge with club-like, apically tuberculated processes | 3. |
| 3. Radula with all teeth differentiated | <i>Plocamopherus</i> |
| Radula with teeth all alike | <i>Kalinga</i> |
| 4. Mantle processes elongated, cylindrical, tubercles on back, rhinophores partially retractile into narrow sheaths. | <i>Limacia</i> |
| These characters not combined | 5. |
| 5. Mantle reduced to an ear-like flap round the rhinophores, and an extra-branchial lobe | <i>Thecacera</i> |
| Mantle reduced to a number of finger-like processes on the frontal margin and outside the gills | <i>Polycera</i> |
| 6. Gills numerous; radula broad | <i>Gymnodoris</i> |
| Gills few, branched; radula with rachidial teeth. | <i>Nembrotha</i> |
| Gills numerous; radula with no teeth | <i>Lecithophorus</i> |

Genus *KALOPLOCAMUS* Bergh, 1880

Kaloplocamus Bergh, 1880, p. 634, footnote; 1884, p. 56, footnote; 1893, p. 11, footnote.
Euplocamus Philippi, 1836, p. 103; (non Latreille, 1809, p. 223, Lepidoptera).
Idalia Leuckart, 1828, pars; Philippi, 1844, p. 76.
Euplocamus Philippi, 1836; Alder, 1845, p. 262; Alder and Hancock, 1855, p. xix;
 Bergh, 1880, p. 623; 1883, p. 165; 1884, p. 56; 1893, p. 11; Vayssière, 1901,
 p. 65; Bergh, 1907, p. 70; Vayssière, 1913, p. 341; O'Donoghue, 1929, p. 775.
Caloplocamus Thiele, 1931, p. 425; Pruvot-Fol, 1954, p. 323.

It is customary to cite the date 1893 in association with this genus name. However, Bergh first mentioned this name in 1880 in a footnote which is repeated

practically verbatim in 1884 and 1893. Bergh used the spelling *Kaloplocamus* which is inconsistent for the Greek letter Kappa should be transliterated the same way each time it occurs. The spelling was corrected by Thiele (1931) but priority insists that the first spelling should stand.

Kaloplocamus ramosus (Cantraine)

- Doris ramosa* Cantraine, 1835, p. 383.
Euplocamus croceus Philippi, 1836, p. 103, pl. vii, fig. 1.
Euplocamus frondosus Philippi, 1839, p. 114, pl. iii, fig. 1.
Euplocamus ramosus Cantraine, 1840, p. 54.
Idalia ramosa (Cantraine): Philippi, 1844, p. 76, pl. xix.
Euplocamus croceus Philippi: Bergh, 1879, pp. 625-36, pl. xi, figs. 9-12, pl. xii, figs. 7-17, pl. xiii, figs. 1-16, pl. xiv, figs. 1, 2.
Euplocamus japonicus Bergh, 1879, pp. 636-9, pl. xiii, fig. 17, pl. xiv, figs. 3-10; 1884, pl. III, fig. 30.
Euplocamus croceus Philippi: Bergh, 1880, pl. x, figs. 1, 2; 1883, pp. 142-4, pl. vi, fig. 10, pl. x, figs. 8, 9; v. Jhering, 1885, p. 35; Bergh, 1893, p. 12; Vayssi re, 1901, pp. 66-70, pl. 5, figs. 1-6, pl. 7, figs. 11-13; Mazzarelli, 1905, p. 1.
Euplocamus croceus Philippi var. *capensis* Bergh, 1907, p. 71, pl. xii, figs. 18-24.
Euplocamus croceus Philippi: Barnard, 1927, p. 194.
Euplocamus ramosus (Cantraine): O'Donoghue, 1929, p. 775.
Caloplocamus ramosus (Cantraine): Baba, 1937, p. 293.
Kaloplocamus ramosus (Cantraine): Baba, 1949, pp. 42-3, 136, text fig. 40, pl. xiii, figs. 46, 47.
Caloplocamus ramosus (Cantraine): Pruvot-Fol, 1951, p. 35, pl. II, figs. 3, 16; 1954, p. 323.

K. ramosus has a wide distribution in the warmer seas of the eastern Atlantic ocean, the Indian ocean and the W. Pacific ocean, having been recorded from the Mediterranean sea, from Japan and from South Africa.

A single specimen was sent to me from the collections of the Zoology Department of the University of Cape Town. It had been dredged in 28 metres on a rocky bottom in False Bay ($34^{\circ} 07\frac{1}{4}'$ S., $18^{\circ} 31'$ E.) in February 1947.

The specimen had lost all trace of colour. Its external structure is very similar to the descriptions and figures given by various authors for Mediterranean specimens. There are seven arborescences on the frontal margin of the mantle, the outermost of these lie immediately under the rhinophores; four arborescences are situated laterally on the margin of the mantle and those on opposite sides of the body lie exactly opposite one another. There are some smaller arborescences on the dorsal surface of the tail. There are five tripinnate gills, the outermost on the right being divided almost to the base so giving the impression of six. The head has the usual ear-like lobed tentacles.

The radula and the labial armature are typical. The genital mass was badly preserved but sufficient to show that there are no significant differences from the figures given by Bergh (1879); this is different from that given by Vayssière (1901) for the same species. Bergh's figures appear to be more correct. The gut was filled with shell débris.

Genus *LIMACIA* Müller, 1781

Limacia Müller, 1781, p. 66.

Luxuria Modeer, 1792, p. 263.

Tritonia Lamarck, 1801, p. 65, non Cuvier, 1798, p. 387.

Euphurus Rafinesque, 1815, p. 122.

Triopa Johnston, 1838, p. 123; Alder and Hancock, 1854, gen. 3; Bergh, 1880, p. 638; 1905, p. 185; 1908, p. 65; Eliot, 1910, p. 152.

Euphurus Iredale, 1918, p. 29; O'Donoghue, 1929, p. 773.

Limacia Müller: Winckworth, 1935, p. 323.

Euphurus Rafinesque: Odhner, 1939, p. 38.

Limacia Müller: Pruvot-Fol, 1951, p. 35; 1954, p. 322.

Limacia clavigera (Müller)

Doris clavigera Müller, 1776, p. 229; 1777, p. 17, pl. 17, figs. 1-3, Gmelin, 1789, p. 3104.

Limacia clavigera Müller, 1781, 66.

Tergipes pulcher Johnston, 1835, p. 490, fig. 59.

Triopa calviger Johnston, 1838, p. 124.

Euplocamus plumosus Thompson, 1840, p. 90, pl. ii, fig. 4.

Triopa clavigera (Müller): Loven, 1846, p. 6; Loven, 1847, p. 189, pl. 3; Alder and Hancock, 1848, Fam. 1, pl. 20; 1854, fam. 1, gen. 3; 1855, pl. 46, suppl. fig. 16.

Triopa lucida Stimpson, 1855, p. 388.

Triopa clavigera (Müller): G. O. Sars, 1878, pl. xiv, fig. 13; Bergh, 1880, pl. xiii, figs. 15-20, pl. xiv, fig. 21, 22, pl. xv, figs. 12, 13; 1881, pp. 640-5, pl. xiii, figs. 9-11, pl. xiv, figs. 1-3; v. Jhering, 1885, p. 32.

Triopa lucida Stimpson: Bergh, 1907, pp. 66-7, pl. xii, figs. 6, 7.

Euphurus claviger (Müller): Iredale and O'Donoghue, 1923, p. 225; Odhner, 1926, p. 24.

Triopa lucida Stimpson: Barnard, 1927, p. 193, pl. xix, fig. 2.

Euphurus claviger (Müller): Odhner, 1939, p. 38.

Limacia clavigera (Müller): Pruvot-Fol, 1951, p. 35; 1954, p. 322.

Eleven specimens have been examined. Four were obtained at Saldanha Bay in September 1949, three at Port Alfred in March 1955, and the remaining four were collected by members of the Department of Zoology of the University of Cape Town in False Bay on August 27, 1951, and February 22, 1952.

The largest specimen in the present collection was obtained in False Bay and measures 40 mm. long by 9 mm. broad and 12 mm. high. The others are all much smaller and average $20 \times 5 \times 5$ mm. The body is plump and the tail is short. The foot is wide, almost as wide as the body, when examined crawling on glass. The animals can, however, climb very narrow strands of seaweed to reach the Bryozoa on which they feed.

The skin is smooth along the sides of the body and warty over the back. The mantle possesses the series of finger-like processes characteristic of the genus. Those on the sides are simple or tuberculated, but those on the frontal margin of the head are tuberculated exactly as shown in Alder's and Hancock's plate (fam. 1, pl. 20). The rhinophores are as usual lamellated and retractile into narrow sheaths. The gills, three or five in number, are not retractile and are arranged in a semi-circle partially enclosing the anal papilla. It is clear that the larger number is derived from the smaller, for the outer gills of the three may be bifid.

The colour is translucent white with the mantle processes, rhinophores, gills and dorsal tubercles all orange yellow in colour. The colour of the gills is usually a little paler and that of the dorsal tubercles darker than the rest.

Spicules of normal form were found in the skin of the Port Alfred specimens, but no spicules were found in the specimens from the west coast and False Bay. This is peculiar for both Bergh (1906) and Alder and Hancock (1848) mention that spicules are abundant.

The radula (fig. 1) is very similar to that described for the European specimens. The number of rows is variable, twenty-five were present in one specimen and thirty-five in another. In each row there are 10-12, 1, 1, 0, 1, 1, 10-12 teeth. There are no rachidial teeth, the first lateral is slender with a long gently curved cusp; the second is similar in length but much stronger and broader. Its cusp is bifid, one of the two denticles is very much more robust than the other. The outer laterals are quadrate without any projecting cusps or points. They fit closely together forming a pavement. Those lying nearest the rachis are darker in colour and apparently stronger than those lying outside them. There are no jaws.

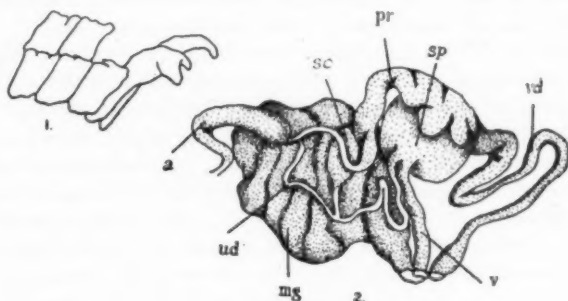
The principal ganglia are arranged in the same fashion as in *Polycera*, an arrangement which appears to be typical for the family.

The genital mass (fig. 2) is also characteristic of the family. The male duct has a voluminous prostatic portion and a coiled muscular portion of similar length. The penis is short, conical and armed. The vagina is straight and quite thick-walled. The spermatheca is large and spherical and lies within the folds of the prostatic portion of the vas deferens. The spermatocystic duct issues from the spermatheca at the same place as the vagina enters, runs close to and parallel with the vagina for a short way then coils between the spermatheca and the albumen gland and shortly before entering the spermatocyst gives off the uterine duct. The spermatocyst may be either sub-spherical or pyriform.

In spite of the absence of spicules from the Cape specimens, there is close agreement between these South African specimens and the European species

L. clavigera and I have no hesitation in including them in this species. They undoubtedly also belong to Stimpson's species *Triopa lucida*, which was first described from Simon's Bay and later fully described by Bergh (1907) and Barnard (1927). There is, therefore, no reason why these two species should not be united.

Absence of spicules in a species which normally possesses them has been recorded previously. According to Meyer and Möbius (1865) specimens of *Ancula*



Limacia clavigera

Fig. 1. Radula teeth.

Fig. 2. Anterior genital mass.

List of abbreviations on figures

a, ampulla of hermaphrodite gland; *a.g.*, albumen gland; *m.g.*, mucous gland; *pr.*, prostatic portion of the vas deferens; *sc.*, spermatocyst; *sp.*, spermatheca; *u.d.*, uterine duct; *v.*, vagina; *v.d.*, muscular portion on the vas deferens.

crinata and *Polycera ocellata* from Kieler Förde have no spicules which, however, are present in specimens from Fanö-Sund and Heligoland. Alder and Hancock also describe spicules from these species on the English coast.

Genus THECACERA Fleming

Thecacera Fleming, 1828, p. 283.

Thecacera Fleming: Alder and Hancock, 1854, fam. 1, gen. 5; 1855, p. xviii; Bergh, 1883, p. 161; Cockerell, 1901, p. 87; Eliot, 1905, p. 241; Cockerell, 1908, p. 106; Eliot, 1910, p. 153; O'Donoghue, 1929, p. 139; Pruvot-Fol, 1954, p. 321.

Thecacera maculata Eliot

Thecacera maculata Eliot, 1905, p. 241.

Thecacera lamellata Barnard, 1935, p. 294, fig. 1.

Six specimens have been examined. Four of them were collected in October, 1950, under a single stone at Kleinemonde some ten miles east of Port Alfred, and two others in December of the same year at Kalk Bay on the coast of the Cape Peninsula.

The largest specimen examined was more than 40 mm. long when fully expanded but shrank to 30 mm. after preservation. All the others were less than 25 mm. fully expanded. They are slender with a very narrow foot and the body is slightly higher than wide. The highest part of the body lies just in front of the gills. The tail is very long and slender and almost half the entire length.

The mantle (pl. XVII, fig. 1) has the form typical of the genus. A pair of finger-like processes lies, one on either side of the gills, and just posterior to them. An ear-like lobe partially surrounds each rhinophore. These lobes are high laterally and lower in front. They do not meet in the middle line so that there is a considerable gap between them on the dorsal surface of the head. The rhinophores are lamellated and partially retractile into narrow sheaths. There are in a horseshoe round the anal papilla five non-retractile, bipinnate gills, with rather small secondary pinnæ.

The head is stout and bulges forwards so that the mouth comes to lie almost immediately beneath the rhinophores. When preserved the head may be retracted and then the mouth appears to be directed forwards. The anterior edges of the foot are prolonged into little tentaculiform processes.

The skin is smooth with sausage-shaped, knobbly spicules embedded in it over the dorsal and lateral aspects, more thickly on the sides than on the back.

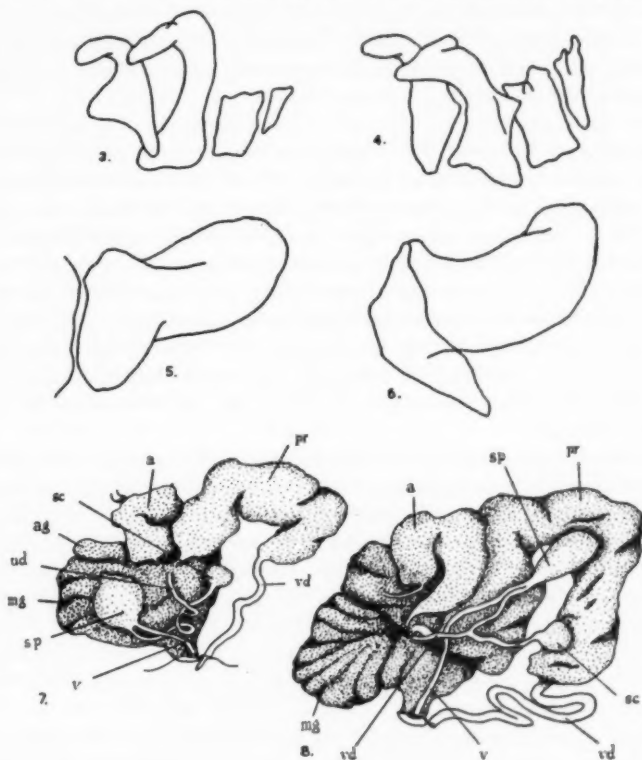
The colour (pl. XVII, fig. 1) of the body is translucent white, through which the underlying organs can be indistinctly seen. Black spots are scattered over the surface of the back and sides of the body, head and appendages. Many of these spots are quite large but they remain discrete and never join up with neighbouring spots. All of them are more or less rounded and not irregular. Splashes of orange-yellow occur on the tips of the gills, on the rhinophore lobes, on the finger-like processes on either side of the gills, on the tail and on the surface of the head at the base of the rhinophores. Two yellow spots lie on the under surface of the head where it overhangs the mouth. The gills are usually orange-coloured though they are paler than the other orange spots. Preserved animals lose all trace of black and of yellow.

The jaws (fig. 5) are very similar to those of species of *Polycera*. The wings are slender and spoon-shaped, the gripping margins slightly thickened but without any true denticulation, although there is a slight roughening of the exposed faces. This roughening takes the form of a series of rows of very tiny denticles, the rows running across the curve of the free surfaces. Jaws of this type are probably used for gripping and holding the prey while the radula scrapes off pieces of a size suitable for swallowing.

The radula (fig. 3) shows a variable number of rows, usually 11-15. In each row there is no rachidian tooth, two laterals are differentiated and two or three are undifferentiated (formula $2/3, 2, 0, 2, 2/3$). The first lateral is smaller than the

second, just more than half its size. Both are hamate with long gently curved cusps and quite strong. There is a lateral spur on the first lateral but not on the second. The third lateral is quadrate and neither cutting edges nor points are developed; it has also a long narrow tail. The fourth is small and triangular and closely applied to the third, the fifth when present is still smaller and liable to escape notice.

The hermaphrodite gland is large and together with the digestive gland occupies most of the posterior regions of the haemocoel of the animal. A narrow hermaphrodite duct leaves and shortly swells into an inflated ampulla (fig. 7),



Thecacera maculata

Fig. 3. Radula teeth.

Fig. 5. Jaw.

Fig. 7. Anterior genital mass.

T. inhacae

Fig. 4. Radula teeth.

Fig. 6. Jaw.

Fig. 8. Anterior genital mass.

whose breadth is very little less than its length. The distal portion of the hermaphrodite duct is also narrow and it splits into the oviduct and vas deferens. The vas deferens quickly widens into a prostatic portion whose walls are glandular and much convoluted. This prostatic portion is very long and wraps round the other organs of the genital complex. There is a distal portion of the vas which constitutes about one-fifth of the entire length. This portion is narrow with muscular walls and slightly bent on itself. It leads to the penis which has a short conical armed glans. The armature is of short blunt spines. The oviduct passes directly into the mass formed by the mucous and albumen glands. The vagina is short and uncoiled and leads to the sub-spherical spermatheca. Thence a longer coiled duct leads to the spermatocyst which lies deep within the mass and communicates with the oviduct by a very short uterine duct.

I have no doubt that it is correct to unite Barnard's *Thecacera lamellata* with Eliot's species from Karachi. The descriptions of the colours given by both authors are almost identical, and Eliot's description will fit South African specimens. The form and arrangement of the mantle lobes and gills are identical. The descriptions of jaws (Eliot's specimens were winged, with the cutting edges irregular but not denticulate) applies equally to South African specimens. Similarly the radulae are very similar. Eliot's specimens had nine rows of 3, 2, 0, 2, 3. Of these the first lateral was hamate, small and spurred near the base; the second larger with a smaller base and with the lower part of the side projecting as a prominent ridge; the third flatter with a low cusp and has the base prolonged into a tail. These remarks could well apply to the specimen I examined. There is also agreement in the shape and armature of the penis.

There is also close similarity between these and the European *Thecacera pennigera*, and the differences which do exist are not important. The orange and black spots are more thickly peppered in *T. pennigera*, which also has three tripinnate gills in contrast to five bipinnate ones. The form of the radula teeth is similar and the spicules are also similar in form and shape. It may well be that all these species are in fact identical, but until further details are known of the European species it is best to retain them as distinct.

Thecacera inhacae n. sp.

A large number of specimens have been examined. Of these most were collected among *Cymodocea* on the banks of the Inhaca channel in Delagoa Bay, while four specimens, which had been collected by Professor J. C. van der Horst at Inhaca, probably in the same locality, were given to me by Professor H. Engel of the Amsterdam Museum.

The following description is based on the holotype collected in the above locality and measuring 32 mm. in length. Paratypes have been deposited in the British Museum (Natural History). The description is supplemented by the study of four paratypes varying between 20 mm. and 50 mm. long when alive.

The mantle is typical of the genus with a pair of broadly based fleshy finger-like processes lateral of the gills and just posterior to them, and with an ear-like flap partially surrounding each rhinophore. The rhinophores are retractile into narrow sheaths. There is a horseshoe of five non-retractile, simply pinnate gills around the anal papilla. (Some other specimens had seven gills.) The head is stout and capable of being retracted some distance into the body. There are tentaculiform processes on the anterior edges of the foot, and a tail of moderate length.

The general body colour (pl. XVII, fig. 2) is a uniform clear translucent orange or yellow, or a colour intermediate between the two. All four mantle processes are tipped with inky blue shading through prussian blue to a clear bluish white apex. A similar colour arrangement runs along the crest of the tail, and is to be found on the tips of the rhinophores and tentacular processes of the foot. The rachis of the gills is inky blue.

The jaws (fig. 6) are very similar to those of *T. maculata*. The radula (fig. 4) has 12 rows of 2, 2, 0, 2, 2 teeth. The teeth show proportions similar to those of *T. maculata*, but possess on the second lateral a spur or wing-like expansion on the outer edge near the base of the tooth.

The genital mass (fig. 8) is large and in the contracted specimens examined lies laterally to the buccal mass. The hermaphrodite gland is large and the hermaphrodite duct long and slender. On entering the anterior genital mass it swells into the ampulla which is much larger than that of *T. maculata* and bent on itself once; its length is about three times its greatest breadth. The ampulla tapers into the distal portion of the hermaphrodite duct which enters between the mucous and albumen glands and the prostatic portion of the vas deferens where it divides into male and female sections. The vas deferens almost immediately widens and swells into the long and voluminous prostatic portion. In the two specimens dissected this prostatic portion is divided into two regions, the proximal is shorter and paler in colour than the distal, but otherwise the external structure is similar. The prostatic portion narrows abruptly into the muscular portion which is long and coiled; in proportion it is longer in this species than it is in *T. maculata*. The glans penis is narrow and armed with blunt spines. The oviduct passes directly into the mass composed of the mucous and albumen glands. The vagina is long and partially coiled and leads to the pear-shaped spermatheca. Thence the uterine duct runs parallel to the vagina for a short way then diverges, and gives off a duct to the almost spherical spermatocyst, and passes into the oviduct before the latter enters the mucous gland. Both spermatheca and spermatocyst lie within the folds of the prostatic portion of the vas deferens. On examining the undissected genital mass only the apex of the pear of the spermatheca is visible and the spermatocyst not at all.

There is no doubt that this is a new species. No description has yet been given of such a brightly coloured species. Only a few North Atlantic species have previously been described and the figures now given of the genital organs are, together with those given above for *T. maculata*, the first to be given for any species of the genus. It is to be noted that they resemble those of *Limacia* more closely than

they do those of *Polycera*. This is particularly so in the arrangement of the ducts leading to and from the spermatheca and spermatocyst which do not have the serial or semi-serial arrangement characteristic of *Polycera* but are arranged in the same way as in *Limacia* with the spermatocystic duct arising from the spermatheca adjacent to the entrance of the vagina, and then running close to and parallel with the vagina for a short distance.

Genus POLYCERA Cuvier

Polycera Cuvier, 1816, p. 389.

Themisto Oken, 1815, p. x and 278, non Oken, 1807, p. 1168.

Polycera Cuvier: Alder, 1841, p. 337.

Cusfaea Leach, 1852, p. 21.

Polycera Cuvier, Alder and Hancock, 1954 genus 6.

Palio Gray, 1857, p. 213.

Polycera Cuvier: Meyer and Möbius, 1865, p. 49; Bergh, 1880, p. 599.

Palio Gray: Bergh, 1883, p. 162.

Polycera Cuvier: Bergh, 1883, p. 163.

Greilada Bergh, 1894, p. 1.

Polycera Cuvier: Vayssière, 1901, p. 62; Eliot, 1910, p. 153; Vayssière, 1913, p. 340.

Palio Gray: Vayssière, 1913, p. 339.

Polycera Cuvier: O'Donoghue, 1929, p. 773; Thiele, 1931, p. 424.

Palio Gray: Thiele, 1931, p. 424.

Polycera Cuvier, Odhner, 1941, p. 10; Pruvot-Fol, 1954, p. 315.

Odhner (1941) recognizes three sections in this genus, namely *Polycera* in the restricted sense, which has one extra-branchial mantle process, *Palio* with many compound ones, and *Greilada* with none at all. The species *P. capensis* to be described below has been grouped within the section *Palio* but this is an error for there is only one extrabranchial process.

Polycera capensis Quoy et Gaimard

Polycera capensis Quoy et Gaimard: 1824, p. 417, pl. lxvi, fig. 4.

Palio capensis (Quoy et Gaimard): Bergh, 1880, p. 163, 1892, p. 1142, sp. dubia.

Palio capensis (Quoy et Gaimard): Smith, 1903, p. 357, sp. dubia.

Palio capensis (Quoy et Gaimard); Barnard, 1927, p. 192.

Polycera nigrocrocea Barnard, 1927, p. 192, pl. xix, figs. 7, 8.

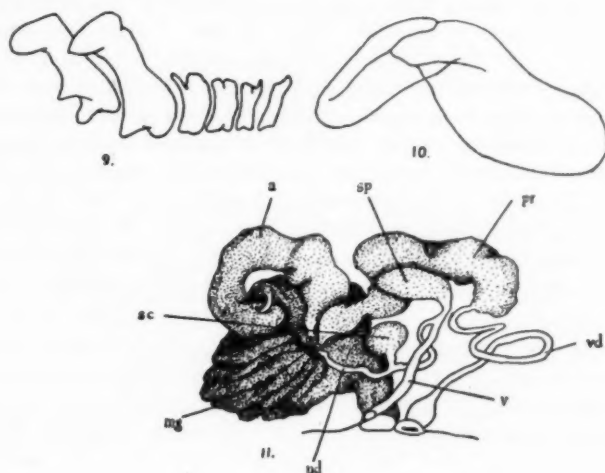
Polycera conspicua Allan, 1932, p. 101, pl. iv, figs. 12, 13, pl. v, fig. 15.

Polycera capensis (Quoy et Gaimard): Pruvot-Fol, 1934, xi, pp. 75, 82; Odhner, 1941, p. 14.

This is one of the commonest Nudibranchs on the southern coasts of Africa. I have collected it at various localities between Saldanha Bay and Port Alfred, and no doubt it extends beyond these two localities, in both directions. It is very frequently found on the bottom of ships among the mass of hydroids and Bryozoans

which grow there, and has been obtained from the slipways at both Table Bay and Port Elizabeth docks. This may explain its wide distribution between Australia and South Africa.

The largest specimens seen exceeded 50 mm. long when fully expanded. In proportion to their length they are very narrow and much higher than broad. The foot is very narrow in preserved specimens yet appears broad when the animal is crawling on a flat surface.



Polycera capensis

Fig. 9. Radula teeth.

Fig. 10. Jaw.

Fig. 11. Anterior genital mass.

In colour and size of mantle processes the species is variable. Normally there are six frontal processes, but individuals have been found in which one or more of these may be bifid, and occasionally the split appears to have reached the base thus giving seven or even eight frontal processes. The length of these processes is also variable. The colour has been described by both Barnard (1927) and Allan (1932) but neither take variation into account. The area covered by both the black and the yellow may vary. Occasionally the black lines are interrupted to such an extent that they become a number of rows of dots rather than continuous lines and they may disappear altogether. I have seen two specimens in which the black has been completely replaced by red. The most variable yellow stripes are those on the tail, but the range of variations covers the descriptions given both by Barnard and by Allan. There seems to be no doubt that Mme Pruvot-Fol (1934) and Odhner (1941) were

quite correct in identifying *P. nigrocrocea* of Barnard and *P. conspicua* of Allan with the older species.

The jaws (fig. 10) are of the same type as those of *P. messinensis* and *P. faroeënsis* described by Odhner (1941). The wing-like processes are broad and the gripping edges heavily cuticularized and very dark in colour. No roughening was noticed on the free gripping edges.

The radula teeth (fig. 9) are typical of the genus. The first two laterals have prominent cusps which appear to be blunt in some aspects but sharp in others. The first lateral but not the second bears a spur towards the base. The outer laterals are much smaller and appear to be bifid. There are four of them decreasing in size outwards.

The ampulla of the hermaphrodite duct (fig. 11) is large and bent on itself, it would appear to be larger in proportion to the rest of the genital mass than it is in the two species (mentioned above) described by Odhner (1941). The prostatic portion of the vas deferens is large and voluminous and the muscular portion is almost equal in length to it. The spermatheca is ovoid and is more or less covered by the folds of the prostatic portion of the vas. The vagina is straight and wide. The uterine duct is coiled, longer and thinner than the vagina, and the spherical spermatocyst lies about halfway along it and connected to it by a short duct.

Genus GYMNODORIS Stimpson

Gymnodoris Stimpson, 1855, p. 379.

Trevelyana Kelaart, 1858a, p. 257; 1858b, p. 111; Alder and Hancock, 1864, p. 132.

Stenodoris Pease, 1871.

Trevelyana Kelaart: Bergh, 1877, p. 440.

Rhodigina Bergh, 1877, p. 446.

Trevelyana Kelaart: Bergh, 1880, p. 185; 1883, p. 139; 1889, p. 850; Eliot, 1904, p. 86; Bergh, 1905, p. 187; Eliot, 1906, p. 667; 1908, p. 100; Odhner, 1917, p. 62; Risbec, 1928, p. 181.

Gymnodoris Stimpson: O'Donoghue, 1929, p. 773.

Trevelyana Kelaart: Pruvot-Fol, 1947, pp. 99, 112; Risbec, 1953, 101.

O'Donoghue (1929) decided that the name *Trevelyana* Kelaart should give way to *Gymnodoris* Stimpson. In this he was followed by Baba (1936 and subsequently). Risbec (1928, 1953) retains *Trevelyana*. On the other hand Mme Pruvot-Fol (1947) stated that there is some uncertainty about this identity. Stimpson's citation of generic characters and his description of *Gymnodoris maculata* do certainly apply to a member of this group. The size of his specimen indicates that it was a young one, and I suggest that it was a juvenile of the well-known *Trevelyana bicolor* or *T. citrina*, species which Risbec (1953), I think correctly, considers to be identical. The figure given by Alder and Hancock (1864) of *T. bicolor* would satisfy Stimpson's rather meagre description.

Up to the present the recorded distribution of *Gymnodoris* is purely Indo-West-Pacific and some of the species have a wide distribution within the area.

In external habitus the genera *Gymnodoris* and *Nembrotha* are very similar, but may readily be distinguished as follows:

<i>Gymnodoris</i>	<i>Nembrotha</i>
1. Usually pale, translucent white or pale yellow with or without orange or red spots.	Predominantly gorgeously coloured in hues of dark blue or green.
2. More than 9, usually simple, gills are present.	Three or five, always much branched, gills, rarely more.
3. Wide radula of awl-shaped teeth, innermost laterals enlarged but not specialized, no rachidial teeth.	Narrow radula, innermost lateral highly specialized, rachidial teeth present.
4. Gonad distinct from digestive gland.	Follicles of gonad and diverticula of digestive gland intertwined.

Specific characters within the genus *Gymnodoris* appear to be few. The colour pattern and the arrangement and form of the gills seem to be the easiest criteria to follow. Slight differences also occur in the form of the radula teeth. Apart from these there is considerable agreement in structure. The arrangement of the ganglia appears to be constant within the genus. Bergh has illustrated the ganglia of *G. crocea* and of *G. alba*, and Vayssi  re those of *G. striata*. All show the same arrangement and similar proportions. My own dissections of the three species described below, indicate that this arrangement is typical of the genus. The anterior genital mass or parts of it have been illustrated by Bergh for *G. alba* and for *G. inornata*. My dissections of *G. ceylonica*, *G. bicolor* and *G. inornata* indicate that there are specific differences in the arrangements of the various ducts and that the presence of a very voluminous prostate which ensheaths the spermatheca is a characteristic of the genus.

It is doubtful if Risbec's decision to establish the genus *Analogium* for *G. striata* (Eliot) is necessary. One diagnostic feature of this species made diagnostic for the genus is the arrangement of the gills in an almost transverse row in front of the anus. One of my two specimens of *G. bicolor* when alive had the gills arranged in a wide crescent rather than a horseshoe, and they appear to be arranged in a transverse row in the preserved specimen. This feature would therefore be insufficient to diagnose a genus.

Gymnodoris ceylonica (Kelaart)

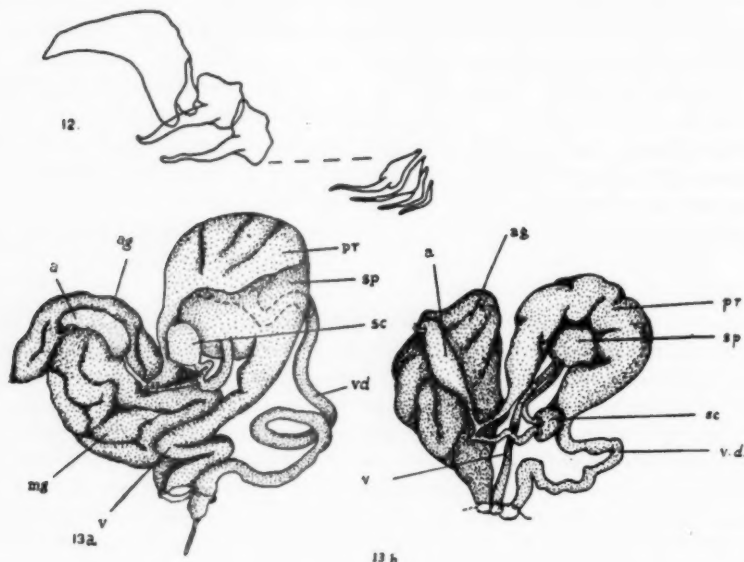
Trevelyana ceylonica Kelaart, 1858a, 257, pl. X, fig. B.

Stenodoris picta Pease, 1871, p. 301, pl. XX, fig. 1.

Trevelyana rubromaculata Bergh, 1905, p. 189, pl. III, fig. 14, pl. XVII, figs. 21-3.

Trevelyanella ceylonica Kelaart: Eliot, 1904, p. 86, pl III, figs. 3a-3c; 1906, p. 669; Risbec, 1928, p. 182, pl VII, fig. 11; Risbec, 1953, p. 97, fig. 56.
 ?*Doris impudica* Rüppell and Leuckart, 1828, p. 33.

Six specimens have been examined. All were collected during 1955 among *Cymnodocea* spp. near the mouth of the Saco da Inhaca in Delagoa Bay. Two were laying eggs.



Cymnodoris ceylonica

Fig. 12. Portion of a row of radula teeth showing innermost and outermost teeth of the row.

Fig. 13a. Anterior genital mass.

Cymnodoris bicolor

Fig. 13b. Anterior genital mass.

When alive the largest specimen of the four was 70 mm. long and 22 mm. broad. The height in front of the gills was 20 mm. and the overall height to the top of the erect and fully expanded gills was 35 mm. The others were slightly smaller, the least being 50 mm. long. They are, thus, of similar length to Bergh's *Siboga* specimens and much bigger than Eliot's from Zanzibar or Kelaart's from Ceylon.

The body is limaciform, and there is a short, broad tail. The skin is soft and supple and bears a number of scattered wart-like protuberances over the dorsal surface. No trace of the mantle can be seen. The head is blunt and rounded and

can be partly retracted so that even the rhinophores become invisible. The rhinophores are perfoliate and not retractile into sheaths. A pair of orange red protuberances above the mouth may represent labial tentacles. The foot is quite broad but narrower than the back. It has clearly defined edges extending laterally as narrow wing-like expansions. The anterior corners are rounded. The gills, in number between nine and fourteen, are bipinnate in the largest specimens, simply pinnate in the smallest one, and are arranged round the anal papilla in an almost complete ring, with only a narrow gap posteriorly.

The colour of all specimens agrees closely with the descriptions given by Kelaart (1858), Eliot (1904) and by Bergh (1905). The general appearance and colour are well shown in Bergh's coloured figure (his pl. III, fig. 14). The general body colour is translucent pinkish white, with the wart-like protuberances on the skin coloured a bright crimson. The rhinophores are tipped with orange, and a thin scarlet line runs along the rachis of each gill. The bluish-brown digestive gland, the orange-red gonad and the pink and red of the anterior genital mass shine through the translucent skin.

The buccal mass is large and strong. The cavity of the mouth is lined by a thin cuticle which extends on to the lips, but there is no distinct labial armature. All the lateral teeth (fig. 12) are awl-shaped, and the innermost lateral is bigger and stronger than the others and extends towards the rachis, it has a widely splayed base plate. The base plates of the innermost laterals are roughly quadrate, of the outermost, ovoid and slender. The radula formula is 32-34, 1, 0, 1, 32-34. There are twenty complete rows and three incomplete rows in the radula of the largest specimen.

The ganglia on the nerve ring are arranged in the same fashion as are those of *G. striata* (Vayssi re, 1912, fig. 34) and *G. alba* var. *pallida* (Bergh, 1883, pl. vi, fig. 11).

The gonad lies on the under and anterior surfaces of the digestive gland and the two may be separated for there is a network of connective tissue fibres between them. The two hermaphrodite ducts (see fig. 13a) unite and swell to form the ampulla which is small in comparison to the rest of the mass. It lies on the inner surface of the albumen gland, and is sausage-shaped. It tapers into the distal portion of the duct which divides. The narrow oviduct receives the uterine duct from the spermatocyst and then swells as its walls become glandular and convoluted in the albumen gland. The mucous gland is comparatively short and convoluted. The terminal portion of the oviduct is short and wide. The vas deferens swells, immediately after its origin, and its walls become strongly convoluted in the prostatic portion. This spreads out over the surface of the spermatheca. The muscular portion of the vas arises abruptly from the prostatic portion. It is quite short. The penis is long and slender, acrembolic and armed with a large number of tiny hooks of varying shape. The vagina is very wide and stout and bent once on itself. It passes to the relatively enormous, subspherical spermatheca. The spermatocystic duct issues separately and some distance from the vagina. It widens into a little

bulb-like chamber where it divides to pass to the spermatocyst and as the uterine duct towards the oviduct. The spermatocyst is pyriform.

This species has been recorded from Ceylon by Kelaart; from Zanzibar by Eliot; from the island of Rotti, near Timor, by the Siboga expedition; and from New Caledonia by Risbec.

Gymnodoris bicolor (Alder and Hancock)

Trevelyana bicolor Alder and Hancock: 1864, p. 440, pl. 29, figs. 11, 12.

Trevelyana citrina Bergh, 1877, pp. 440-3, pl. lvi, figs. 18-25.

Trevelyana bicolor Alder and Hancock, Farran, 1905, p. 346.

Trevelyana perlucens Risbec, 1928, pp. 185-9, text fig. 57, 57 bis, pl. 1, fig. 12, pl. V, fig. 1.

Trevelyana suggens Risbec, 1928, pp. 190-3, text-fig. 58, pl. B, fig. 1, pl. V, figs. 3, 6; pl. VII, fig. 10.

Trevelyana japonica Baba, 1930b, p. 46.

Gymnodoris citrina (Bergh): Baba, 1937, p. 292, pl. 1, fig. 9; 1949, pp. 40, 135, text-fig. 35, pl. XI, figs. 37, 38.

Trevelyana bicolor Alder and Hancock: Risbec, 1953, pp. 98-101, text-fig. 57.

?*Gymnodoris maculata* Stimpson, 1855, p. 379.

Two specimens were found in July 1956, on the shores of the Saco de Inhaca, a bay on the island of Inhaca at the entrance to Delagoa Bay. They were found among the scraps of decaying flesh which remained in a shell of *Atrina squamifera*. Whether the nudibranchs were there for food or shelter is not known, though their presence among the decaying flesh may suggest that they were feeding.

The two specimens were 32 mm. and 19 mm. long, respectively, when alive. The appearance and proportions agree with the coloured illustration given by Alder and Hancock (1864) and with the description and coloured illustrations given by Risbec (1928) and by Baba (1937, 1949). One feature not mentioned by any of these authors is that when the animals are alive the gills, nine in number in the present specimens, are arranged in a wide horseshoe round the anal papilla but in the preserved specimens the gills appear to be in a straight line.

In the skin are embedded numerous spicules, which are sausage-shaped and slightly curved, of the same form as those illustrated by Risbec (1928) for *T. suggens*.

The buccal mass is large, typical of the family and without a buccal pump. The buccal cavity is lined by a very thin cuticular membrane which extends up to the posterior margin of but does not pass on to the lips. There is no labial armature. The radula formula of the larger specimen is 18 rows of 21, 1, 0, 1, 21 teeth, numbers which fall in the middle of the range quoted by Baba (1949). All the teeth have the shape illustrated by Baba.

The ganglia on the nerve ring, like those of *G. ceylonica* are arranged in the same pattern as are those of *G. striata*. This pattern is different from that given by Risbec (1928).

As in *G. ceylonica* the gonad lies under the anterior portion of the digestive gland and may easily be separated from it. The form and arrangement of the anterior genital mass differs somewhat from that of *G. ceylonica* as may be seen by comparing figures 13a and 13b. Particularly to be noticed is the directness and narrowness of the spermathecal duct, and the arrangement of the spermatocystic and uterine ducts. The spermatheca and spermatocyst are arranged serially as opposed to the semi-serial arrangement found in *G. ceylonica*. The terminal muscular portion of the vas deferens is shorter and the prostatic portion much longer and more voluminous than in *G. ceylonica* and it completely conceals the spermatheca.

The present records extend the distribution of this species to the warmer waters of Southern Africa. It has an entirely Indo-West-Pacific distribution being recorded from South India by Alder and Hancock; from the Pelew islands by Bergh; from Japan by Baba and from New Caledonia by Risbec.

Gymnodoris inornata (Bergh)

Trevelyana inornata Bergh, 1880, pp. 186-90, pl. iii, figs. 14-17, pl. iv, figs. 8-14, pl. v, figs. 1-9; 1905, pp. 188-9, pl. xvii, figs. 16-19.

Gymnodoris inornata (Bergh): Baba, 1937, pl. 1, fig. 8; 1949, pp. 41, 135, text-fig. 37, pl. xii, figs. 41-3.

A single specimen 25 mm. long was collected with the two specimens of the former species (*bicolor*), and may like them have been feeding on the decaying flesh in the shell, in which they were all found.

The specimen was a pale translucent orange and had a crescent of eight gills round the anal papilla. In appearance it was very similar to specimens illustrated by Baba.

There were no spicules embedded in the skin. The ring of ganglia is arranged as in other members of the genus. The organs of the anterior genital mass have the form shown by *G. ceylonica* with a semiserial arrangement of spermatheca and spermatocyst. The terminal portion of the vas deferens is longer in proportion to the rest than it is in *G. ceylonica* and is coiled in a flattish spiral. The buccal mass has the form typical of the family and the radula has 23 rows of 17-21, 1, 0, 1, 17-21 teeth. The form of the teeth agrees with the illustrations by Bergh and Baba.

Apart from the record from Indonesia by the Siboga expedition, this is the first record of this species outside Japan.

Genus NEMBROTHA Bergh

(?) *Angasiella* Crosse, 1864, p. 8.

Nembrotha Bergh, 1877, pp. 450-1?; 1881, pp. 658-9; 1883, pp. 164-5; 1892, p. 152; Eliot, 1904, p. 89; Bergh, 1905, p. 193; 1907, p. 67; Eliot, 1908, p. 98; O'Donoghue, 1924, p. 567.

Angasiella Crosse: O'Donoghue, 1929, p. 734.

Nembrotha Bergh: Allan, 1933, p. 449; Eales, 1938, p. 95.

The proper name to be ascribed to this predominantly Indo-West-Pacific genus presents certain difficulties. O'Donoghue (1929) states that the name ought to be *Angasiella* because Bergh on one occasion lists the species *A. edwardsi* as a species of *Nembrotha*. On later occasions, however, Bergh (1883 and 1907) lists it with a query. Eliot (1908) has also commented on the possible identity of the two genera. There is still considerable doubt, for the Australian species has not been encountered since its discovery. I consider, therefore, that for the present it is probably best to continue to use Bergh's name for the genus, but one must always bear in mind the possibility that it may have to change if and when the species *Angasiella edwardsi* is found for the second time.

The genus is characterized by partially retractile rhinophores and a small number of bipinnate or tripinnate gills and by the absence of a definite mantle rudiment. Internally the most diagnostic characters are the presence of a rachidial tooth on the radula and in some species, but not in others, the absence of a definite prostatic portion of the vas deferens. Most species have a striking, if sombre, colour pattern, most frequently of dark greens and blues. The skin is often velvety in appearance.

Many of the species ascribed to the genus bear a close resemblance to others. Eliot (1904) has suggested that *N. nigerrima*, *N. kubaryana* and *N. cristata* are in fact variations of one species with a broad radula; all have a broadly similar colouration. Similarly the Philippine and Japanese *N. gracilis* is very similar to East African *N. affinis* and these may represent different facies of the same species. The coloured illustration given by Bergh (1905) of *N. morosa* is virtually identical with Barnard's (1927) figure of *N. capensis*. Further the figures given by Bergh (1905, 1907) of the radula of both these species are compatible with one another. Also the radula of *N. amitina* is of the same pattern and the description given will fit a small specimen of *N. morosa*. I have no doubt that these three are all conspecific.

Nembrotha morosa Bergh

Nembrotha morosa Bergh, 1877, p. 457-8, pl. 33, fig. 7 (pl. 25, fig. 9 in Bergh, 1874, col. fig. of *Trevelyana morosa*); Bergh, 1905, p. 195, pl. 4, fig. 13, pl. 18, figs. 9-12.

Nembrotha amitina Bergh, 1905, p. 201, pl. 18, figs. 23-8.

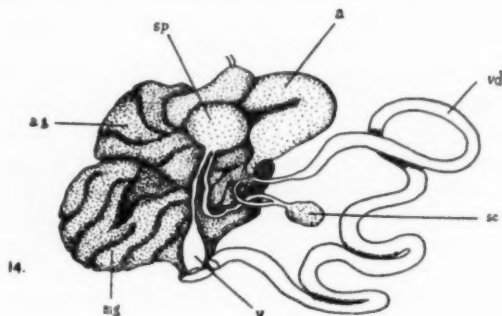
Nembrotha capensis Bergh, 1907, pp. 68-70, pl. 12, figs. 8-17; Barnard 1927, pp. 196-7, pl. 19, fig. 10.

Eight specimens have been collected at various localities on the False Bay coast between Kalk Bay and Miller's Point, chiefly in May 1949; two of these have been dissected.

The dimensions of the largest specimen found were 8 cm. \times 3 cm. \times 3 cm. (height to top of gills) when it was alive.

The colour of the animal is a dark bluish black with two thin light green lines along the sides of the back; these lines join in front of the rhinophores and on the surface of the tail. The axes of the gills are bluish black and the filaments paler. Similarly the tips of the rhinophores are a pale bluish green.

The buccal cavity is lined by a clear chitinous membrane which is continuous with the armature of the lips, and reflexed round them. In view of the peculiar nature of the buccal armature of the genus *Lecithophorus*, established below, it is of interest to note the development in a species of *Nembrotha* of a lining to the buccal cavity. Into this cavity projects the odontophore which is also covered by a thin membranous sheath. The radula has been adequately described by Bergh (1905 and in greater detail in 1907). The specimen examined had 19 rows with 5, 1, 1, 1, 5 teeth in each row. The intermediate tooth is large and presents different appearances when viewed from different angles. It is falciform and strongly hooked.



Nembrotha morosa

Fig. 14. Anterior genital mass.

The chief characteristic of the anterior genital mass (fig. 14) is the absence of a prostatic portion of the vas deferens. Bergh has on several occasions mentioned that this is diagnostic of the genus, but this is not correct. Eales (1938) has demonstrated that *N. lineolata* has a prostate. I have recently dissected a specimen of *N. nigerrima* from Mauritius, and this species has a large and complex prostatic portion of the vas deferens which surrounds the spermatheca in the same manner as in other Polycerids. Bergh (1880) actually mistook this for the mucous gland. It would appear that this presence or absence of a prostate is a specific character within the genus. The vas deferens is quite long and coiled, rather narrow, but of the same diameter throughout its length. The penis is armed with tiny spinules, as described by Bergh. The ampulla of the hermaphrodite duct is large and very wide. It is longer than is usual in this family and bent twice on itself. The spermatheca is sub-spherical and the vagina direct, and rather broad, with a bulbous portion just within the external opening. The uterine duct which is much narrower than the vagina

and slightly coiled, passes to the pyriform spermatocyst, thence on to the oviduct. The last portion of the duct is very short and enters close to the origin of the oviduct. The mucous and albumen glands are as usual.

Distribution. Indonesia, South Africa.

Genus *Lecithophorus* gen. nov.

In appearance the specimens on which this genus has been founded are very similar to certain species of the genus *Gymnodoris*. There is, however, a remnant of the mantle visible as a rim very slightly elevated above the general body contour. Dissection of the buccal mass reveals a much more significant difference. There is no trace of a radula with teeth. Within the buccal cavity there is a membranous lining resistant to the action of potassium hydroxide. This lining has the form of a bottle with the neck directed outwards, and protruding into the base of the 'bottle' there is a cover to the odontophore, bearing a structure which is probably the base plate of the radula, and completely devoid of teeth.

This structure is reminiscent of the cuticular lining of the buccal cavity of *Nembrotha morosa*, and a similar cuticular lining has been described by Bergh (1883, 1905) for the group *N. nigerrima*, *N. kubaryana* and *N. cristata*. Such an armature is also present in *Gymnodoris ceylonica*. Another close similarity between *Lecithophorus* and *Nembrotha* is to be found in the arrangement of organs in the genital mass. The disposition of spermatheca and spermatocyst is similar in the two genera and the lack of a separate prostatic portion of the vas deferens is common to *Lecithophorus* and to *Nembrotha morosa*.

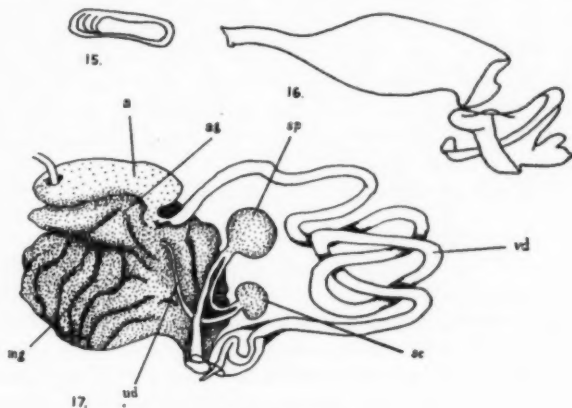
The definition of the genus *Lecithophorus* is as follows: Doridacean nudibranchiate mollusca with the gills simply pinnate, not retractile, and arranged in a ring round the anus; with a rudiment of the mantle in the form of a rim slightly elevated above the body contour; having the buccal cavity with a cuticular lining and neither jaws nor radula. This genus is closely related to *Nembrotha*.

Lecithophorus capensis n. sp.

Eight specimens have been examined. They were found under stones at Miller's Point on the False Bay coast of the Cape Peninsula and also at Kalk Bay on the same coast, in January 1950, and January 1951.

The largest specimen used as holotype, was 19 mm. long and 5 mm. broad, when it was alive and fully extended. Others were only slightly smaller. In general shape and colour (pl. XVII, fig. 3) it is reminiscent of grey garden slugs. The mantle is much reduced and is represented by a rim very slightly raised above the general body outline and more conspicuous in preserved than in living specimens. It runs from a point about halfway along the tail (the tail being considered as that portion of the body which lies behind the anus) on each side and passes right round the front of the head. The rhinophores are short and stout with a club-shaped perfoliate head

terminating in a little point. They are partially retractile into hollows. The gills are disposed in a full circle round the anal papilla. In the holotype there are 14 of them and the number may vary between 10 and 15, the number being correlated to some extent with the size of the specimen. Each gill is simply pinnate and in the preserved animals all are bent inwards showing only the main rachis of the gill. The anal papilla and the group of gills lie rather farther forward than may be expected, and appear to be in the anterior half of the animal. The foot is at least as broad as the back. The head is large and stout and when the animal is alive tends to bulge forward well in advance of the foot. The buccal mass is capable of being withdrawn far into the body cavity. The skin is smooth and embedded in it are a large number



Lacithophorus capensis

Fig. 15. Spicule from skin.

Fig. 16. Buccal armature.

Fig. 17. Anterior genital mass.

of spicules. Most of these are sausage-shaped (fig. 15), clear and transparent in the middle region and with what may be lines of growth at either end. These may be more strongly developed at one end than at the other. Small spherical or disc-like spicules are also present.

The colour (pl. XVII, fig. 3) of the body is translucent white and the internal organs may be seen shining through as brownish areas. Pale lemon yellow patches indicate the position of the buccal mass and gonad. The position of the spicules may also be clearly seen.

In most of the preserved specimens the buccal mass is withdrawn far into the body cavity, and to the left. It thus comes to lie adjacent to the anterior organs in the genital mass. Anterior to the buccal mass, in this retracted condition, there is a muscular tube. The buccal mass is typical in shape. The salivary glands are small, about one-third of the total length of the mass. The radula sac is small.

The buccal cavity is lined by a membranous sheath, in shape like a long-necked narrow-mouthed bottle (fig. 16). The lip of the bottle is slightly reflexed. Into the widish body of the bottle projects the cuticularized cover of the odontophore, bearing a curved piece which represents the basal plate of the radula. So far as I am aware no similar structure has been described in any other Mollusc.

Some of the specimens were found among Didemnid ascidians and probably they feed on these. The radula and odontophore may act within the 'bottle of the buccal cavity' after the fashion of the plunger of a pump.

The genital mass (fig. 17) is quite typical of the group. There is, however, no distinct prostatic portion of the vas deferens. In this it agrees with *Nembrotha morosa*. The vas is simple and of uniform diameter throughout its length. The penis is long and narrow and armed with tiny spines. It can be withdrawn into a flask-shaped praeputium which lies just within the male pore. The vagina is short leading directly to a spherical spermatheca. The uterine duct runs parallel to the vaginal duct for about half its length, then a short spermatocystic duct diverges, the uterine duct continues on a slightly coiled course to the oviduct. This second portion of the uterine duct is longer and more coiled than the other portion. The male duct and the spermatheca and spermatocyst are displaced anteriorly when the buccal mass is withdrawn.

Family GONIODORIDIDAE

This family was separated by Bergh (1893) from Alder and Hancock's comprehensive family Polyceridae. Since then its status has been unchallenged, until Thiele (1931) once again placed it within the Polyceridae with the status of a sub-family. This course is untenable because the Goniodorididae show several features which may be used to separate them from the Polyceridae. For example there is a pair of well-developed velar tentacles, which are absent from the Polyceridae and also they possess an *ingluvies buccalis* which is not to be found among the Polyceridae.

Iredale and O'Donoghue (1923) and O'Donoghue (1926, 1929) prefer the use of the name Okeniidae for the family but the other use has priority.

Genus GONIODORIS Forbes and Goodsir

Goniodoris Forbes and Goodsir, 1839, p. 647.

Goniodoris Forbes and Goodsir: Forbes, 1840, p. 104; Gray, 1850, vol. iv, p. 104.

Pelagella Gray, 1850, vol. iv, p. 105.

Goniodoris Forbes and Goodsir, 1839, p. 647.

Goniodoris Forbes and Goodsir: Alder and Hancock, 1854, genus 2; 1885, p. 43, app. p. xviii?; 1864, p. 130.

Lophodoris Sars, 1878, p. 364.

Goniodoris Forbes and Goodsir: Bergh, 1879, p. 365; 1880, p. 115; 1883, p. 173; Vayssière, 1901, p. 73; Eliot, 1905, p. 243; 1910, p. 157; Vayssière, 1913, p. 349; Thiele, 1931, p. 428; Pruvot-Fol, 1954, p. 307.

Goniodoris mercurialis n. sp.

Three specimens have been examined. They were collected at Kalk Bay in November, 1949.

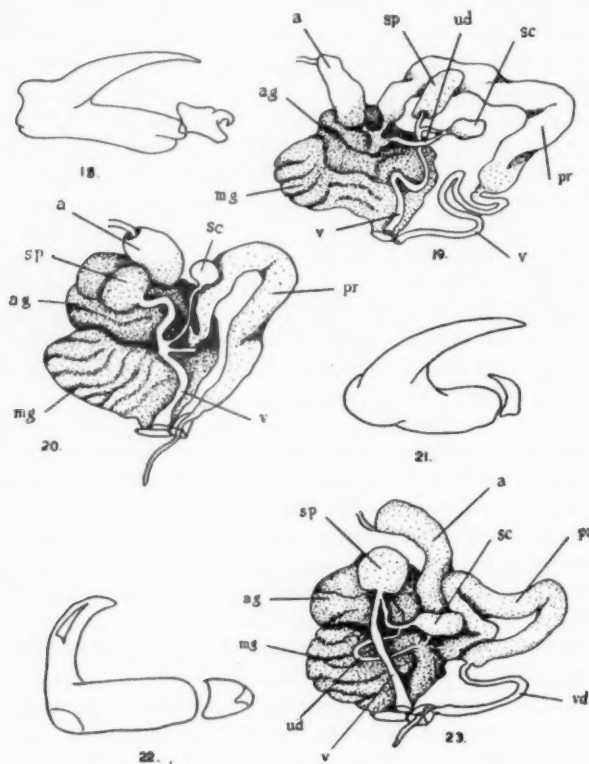
The largest of the three, the holotype, was 20 mm. long by 10 mm. broad. It shrank in preservative to about three-fifths of these dimensions. The mantle is well developed and extends round the body except for a short region on the back just behind the circlet of gills. It does not extend on to the tail. In life it is held erect and stands out at right angles to the body surface. The rhinophores, not retractile though capable of strong contraction, lie within the mantle edge close to the point where it turns round the sides of the head. The head bears well-developed oral tentacles connected in front by a slightly developed velum. This reduced velum is much more prominent than in most species of *Goniodoris*. The foot is very broad, much broader than the back and when its edges are fully extended, these are strongly reminiscent of the parapodia of Aplysiids. The tail is short and blunt. There is no median ridge on the back of the body nor on the tail. The anal papilla is surrounded by a circlet of gills. There are nine in the holotype and seven in the others; the higher number is, no doubt derived from the smaller by the subdivision of one or more. Most of the gills are completely pinnate, either quadripinnate or tripinnate but the smaller ones are usually bipinnate. The renal aperture lies in the first sector to the right of the middle line in front of the anal papilla.

The colouration (pl. XVIII, fig. 4) is striking, though of a concealing nature. The basal colour is a translucent lemon yellow overlain by a flush of pink, so giving the general impression of a pale buff. There are tiny spots and specks of opaque white, chocolate brown and black. The tips of the gills and rhinophores and the edge of the mantle are lemon yellow. The back within the circlet of gills is darker as a result of the shining through of the digestive gland. The general colour of the specimens was closely similar to that of the compound ascidians on which they were found feeding.

The buccal mass has the typical Goniodorid form. The radula is well developed, long and narrow. In the specimen there are 29 rows of 1, 1, 0, 1, 1. There is no rachidial tooth. The intermediate tooth (fig. 18) is very large, its base is broadly rectangular in outline and the cusp is elongated, finely tapered and without any denticulation. The outer tooth has a quadrate base, and a strongly curved hook-like cusp, which is very small in comparison with the base.

The anterior genital mass (fig. 19) is very similar to that of most other Goniodorids whose genitalia have been described. The ampulla is short and inflated; the distal portion of the hermaphrodite duct is very short and soon bifurcates into male and female portions. The vas deferens almost immediately swells into a prostatic portion which occupies most of the length of the vas. The distal portion of the vas is about two-thirds the length of the prostatic portion, slightly coiled and very slender. The penis is elongated, slender and acrembolic, armed with numerous fine spinules throughout its length. Its proximal portion is very short and passes into the

mass of the mucous and albumen glands. The vagina is narrow and slightly coiled, the spermatheca ovoid. For a short distance the uterine duct runs parallel with the vagina then it diverges to pass close to the spermatocyst with which it communicates by a very short duct. It then proceeds directly to the oviduct which is entered close to the mucous gland.



Goniodoris mercurialis

Fig. 18. Radula teeth.

Fig. 19. Anterior genital mass.

Goniodoris brunnea

Fig. 20. Radula teeth.

Fig. 21. Anterior genital mass.

Okenia amoenula

Fig. 22. Radula teeth.

Fig. 23. Anterior genital mass.

This species appears to be peculiar in the strong development of the edges of the foot, and the specific name given to it draws attention to the winged appendages of the foot. The form of the outer laterals on the radula also seems to be diagnostic.

The general colour resembles that of *G. ovata* Barnard (1932), but that species has no outer lateral teeth on the radula, hence the two are distinct.

Goniodoris brunnea n. sp.

Three specimens have been examined. They were found under a stone at Kleinemonde some ten miles east of Port Alfred in November 1950. The largest on which the following description is based measured 22 mm. long by 10 mm. broad. It shows the external characters of the genus in the form of the mantle and the general appearance of the body. The mantle edge is entire along the sides of the body and along the frontal margin of the head, but it does not extend behind the gills. It is held upright and does not envelop the sides of the animal. There is also a median ridge which begins between the rhinophores and, interrupted by the circlet of gills, passes right down the dorsal surface of the tail. The rhinophores are perfoliate and contractile but not retractile. There are complexly pinnate gills, five on the holotype, seven on one of the others. The general surface of the body is tuberculate. The foot is very wide, wider than the rest of the body. A pair of velar tentacles overhangs the mouth.

The colour (pl. XVIII, fig. 5) is a translucent white peppered with abundant flecks of chocolate brown over the whole of the dorsal surface and the appendages. Scattered over the entire body surface, mantle and rhinophores are patches of orange and creamy white opaque spots, the spots being closely aggregated into patches. The gills show the deep chocolate spotting only, and thus look darker than the general body surface. Considerable variation in the density of the flecking seems to be possible, for all three specimens are different.

The buccal mass has the usual Goniodorid facies. The radula is well developed with about thirty rows. There is no rachidial tooth, the intermediate lateral (fig. 21) is as usual large, with a slightly curved, broadly rectangular base and a strong cusp, as long as but more slender than the base. There are no denticulations on the teeth.

The genital mass (fig. 20) is comparatively simple and easily unravelled. The ampulla is short and only slightly curved. The male duct has a long wide prostatic portion, bent once on itself and short non-glandular portions at either end. The penis is acrembolic and unarmed. It is very long and slender. It appears to be not a true penis but merely the evaginated distal portion of the vas deferens. The spermatheca and spermatocyst are both sub-spherical and lie between the prostatic portion of the vas and the mucous and albumen glands. The vagina is about the same length as the extended penis and only slightly coiled. For most of their length the uterine duct and vagina lie parallel to one another, the spermatocystic branch is of moderate length.

There is a superficial resemblance between this species and the European and Mediterranean *G. castanea*. However, the radula teeth of *G. brunnea* are unarmed and the outer laterals minute and hook-like contrasting with the armed teeth and quadrate outer laterals of *G. castanea*. *G. aspera* from south India is also very similar in appearance but it is said to have rudimentary jaws which have not been detected in *G. brunnea*. *G. aspera* has not been found since Alder and Hancock published their description in 1864 and subsequent examination and comparison may show that these two are in fact conspecific.

Genus OKENIA Menke

Okenia Menke, 1830, p. 10.

Idalia Leuckart, 1828, p. 15, *non* Hübner, 1820, p. 149.

Idalia Leuckart: Alder, 1845, p. 262; Alder and Hancock, 1854, genus 8; 1855, p. 45, app. p. xviii; Bergh, 1881, p. 142.

Idaliella Bergh, 1881, p. 145.

Idalia Leuckart: Bergh, 1883, p. 173; Vayssière, 1901, p. 78; Eliot, 1910, p. 158; Vayssière, 1913, p. 353; 1919, p. 76.

Okenia Menke: Iredale and O'Donoghue, 1923, p. 217; Thiele, 1931, p. 428; Pruvot-Fol, 1954, p. 308.

Okenia amoenula Bergh

Idaliella amoenula Bergh, 1907, pp. 80-2, pl. xiii, figs. 8-11; Barnard, 1927, p. 107.

Two specimens which were collected at Kleinemonde some ten miles east of Port Alfred in November 1950, have been examined.

Both were very similar in size and while alive were 12 mm. long by 5 mm. broad by 3 mm. high. Members of this genus are typically elegant forms and this species is no exception.

The mantle edge (pl. XVIII, fig. 6) is split up into highly mobile tentaculate processes symmetrically arranged, nine on each side, the ninth on each side is deeply cleft and one or more of the others are bifid at the tip. The rhinophores are perfoliate and non-retractile, though highly contractile. There is a horseshoe of ten gills arranged round the anus, the horseshoe is open behind. The gills are simply pinnate and the most posterior pair is very small. All are contractile but not retractile. The tail is short and broad, occupying about one-quarter of the total length. The foot is wide and the anterior angles are rounded. The genital opening is on the right between the third and fourth mantle processes. On either side of the mouth are two tentacle-like velar flaps, which meet in the middle and overhang the mouth.

The colour (pl. XVIII, fig. 6) is translucent white, and calcareous spicules can be seen embedded in the skin on the dorsal surface and of the sides. A yellow line runs along the middle of the back from a point between the rhinophores and is interrupted just in front of the gills; behind the gill it continues along the tail and ends at the tip. These yellow lines are to a varying extent overlaid by a line of brick red.

Patches of brick red lie along the inner edge of the mantle, between the gills and along the sides of the body below the mantle edge. These patches and lines vary somewhat in the two specimens examined. The mantle processes and the gills are tipped with yellow overlaid by brick red. The yellow and brick red are continued along the bases of the two anterior mantle processes but in only these two does it descend from the tips. The rhinophores are tipped with pale yellow, and a yellow line runs round the velar tentacles just within the margin.

Eggs were laid in a thick clear gelatinous rope about 1 mm. across, coiled in a loose spiral. Within this rope the eggs seemed to be arranged in no definite order.

The radula has the form described by Bergh, and the teeth (fig. 22) show the appearance given in his figures. The denticulation on the cusp of the intermediate tooth is, however, much finer than Bergh shows, in fact it is visible only with the high power of the microscope. The outer lateral also has a slight recurved cusp. These differences are insufficient to separate these specimens from Bergh's species.

The genital mass (fig. 23) has the typical Goniodoridid facies and bears a close resemblance to the figures given by Vayssi re (1919) of the genital organs of *O. elegans*. There are, however, some differences, particularly in the proportion of the spermatheca, spermatocyst and ampulla. The ampulla of *O. amoenula* is not large, it is sausage-shaped, and rather slender, embedded between the mucous and albumen glands and the prostatic portion of the vas deferens. The proximal portion of the vas is short, the prostatic portion very long and coiled so as to enwrap the anterior and inner faces of the other organs. The muscular portion of the vas is elongated and narrow, the penis short and spiny. The spermatheca and spermatocyst lie on the outer surface of the mass and close together. The former is rounded ovate and the latter elongate ovate in shape. The vagina is simple. The uterine duct is slender, long and slightly coiled. The mucous and albumen glands are as usual.

Paratypes of the new species described in this paper and in two previous papers, viz.:

'On some Eolidacean Nudibranchiate Molluscs from South Africa.' *Ann. Natal Mus.*, 13, 1954, 1-50, and

'On four sacoglossan molluscs new to South Africa.' *ibid.*, 51-64, have been deposited in the British Museum (Natural History). I have retained in my own collections slides of radulae and jaws and the remains after dissection of the type specimens. The first locality mentioned in the description of each new species is the type locality for that species.

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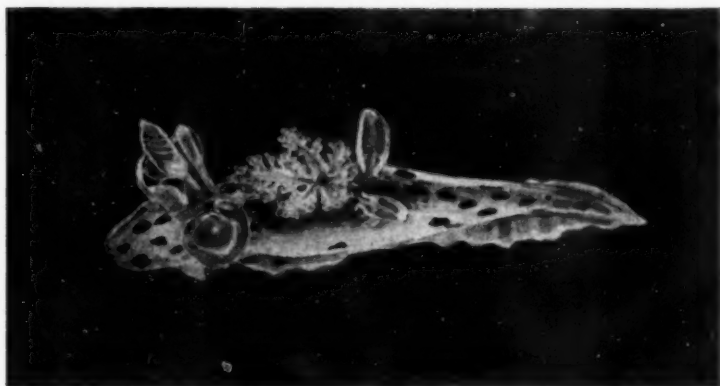


Fig. 1



Fig. 2

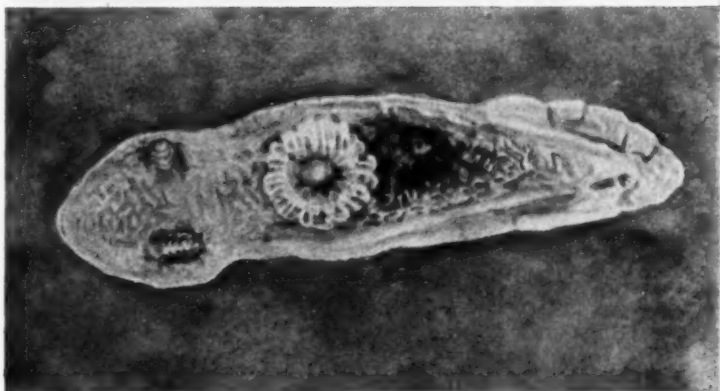
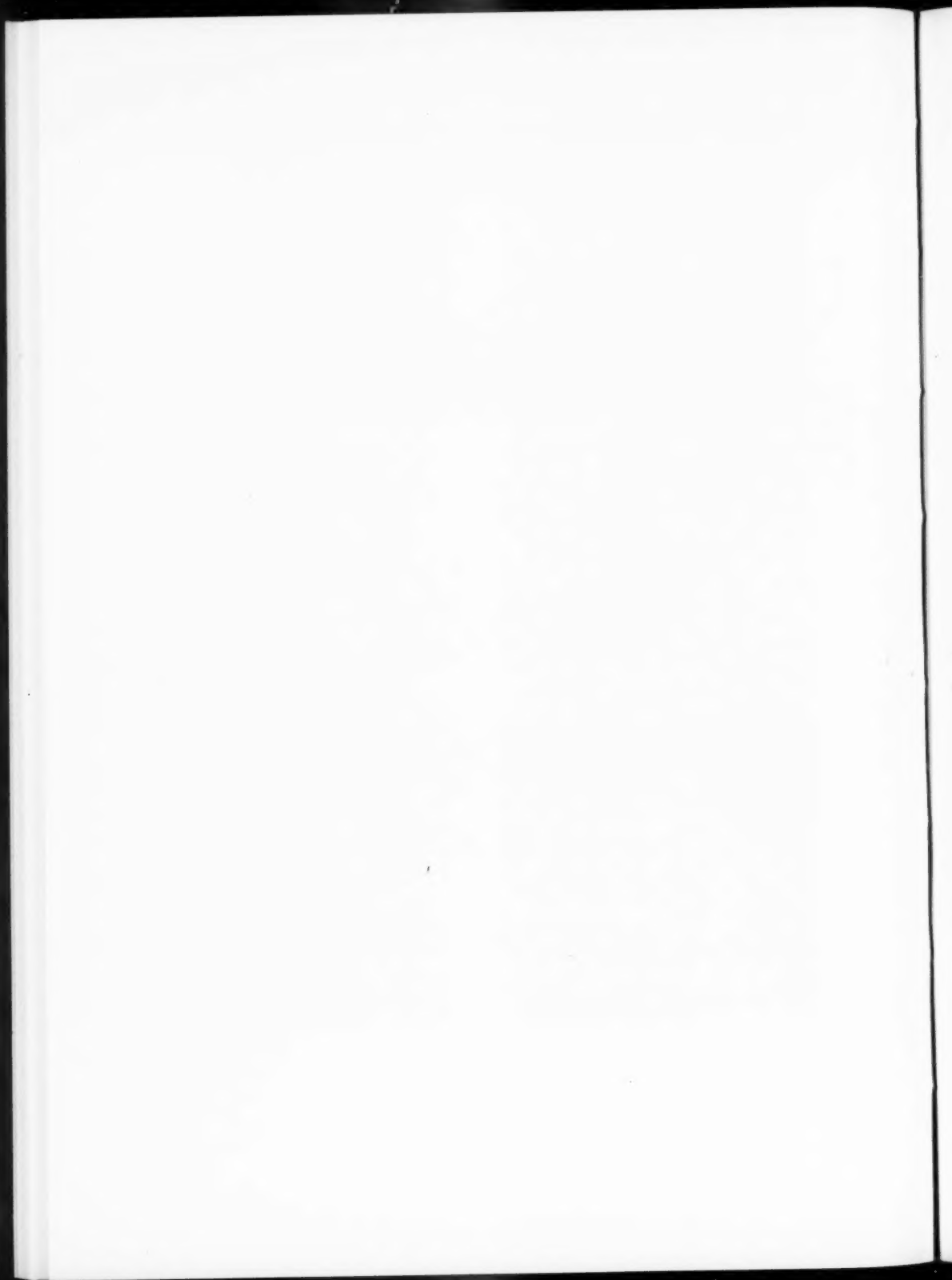


Fig. 3

- Fig. 1. *Thecacera maculata* Eliot.
 Fig. 2. *Thecacera inhacae* n. sp.
 Fig. 3. *Lecithobhorus capensis* n. sp.

All painted from nature, except fig. 2 which is taken from a coloured photograph by E. B. Edney (the blue shadow indicates the dorsal processes).



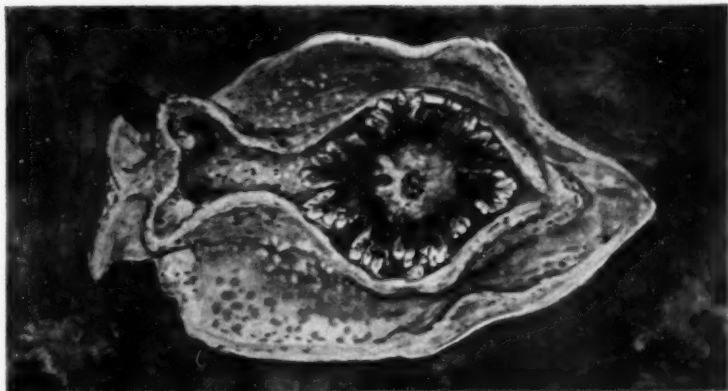


Fig. 4

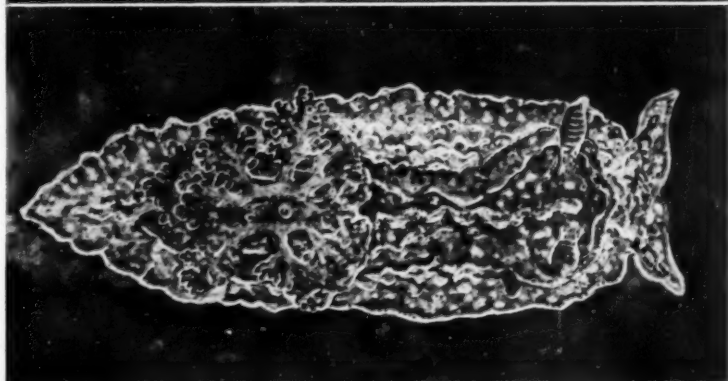


Fig. 5

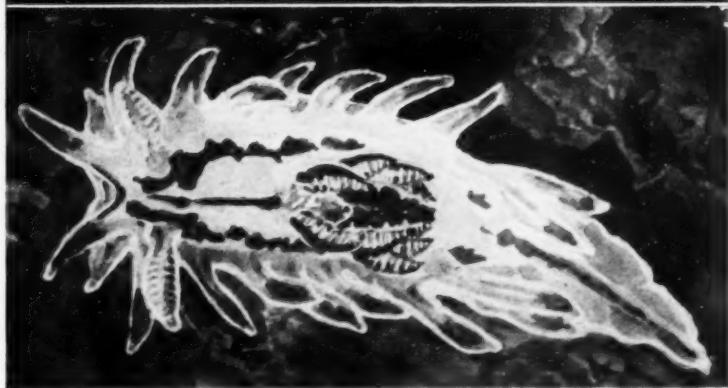


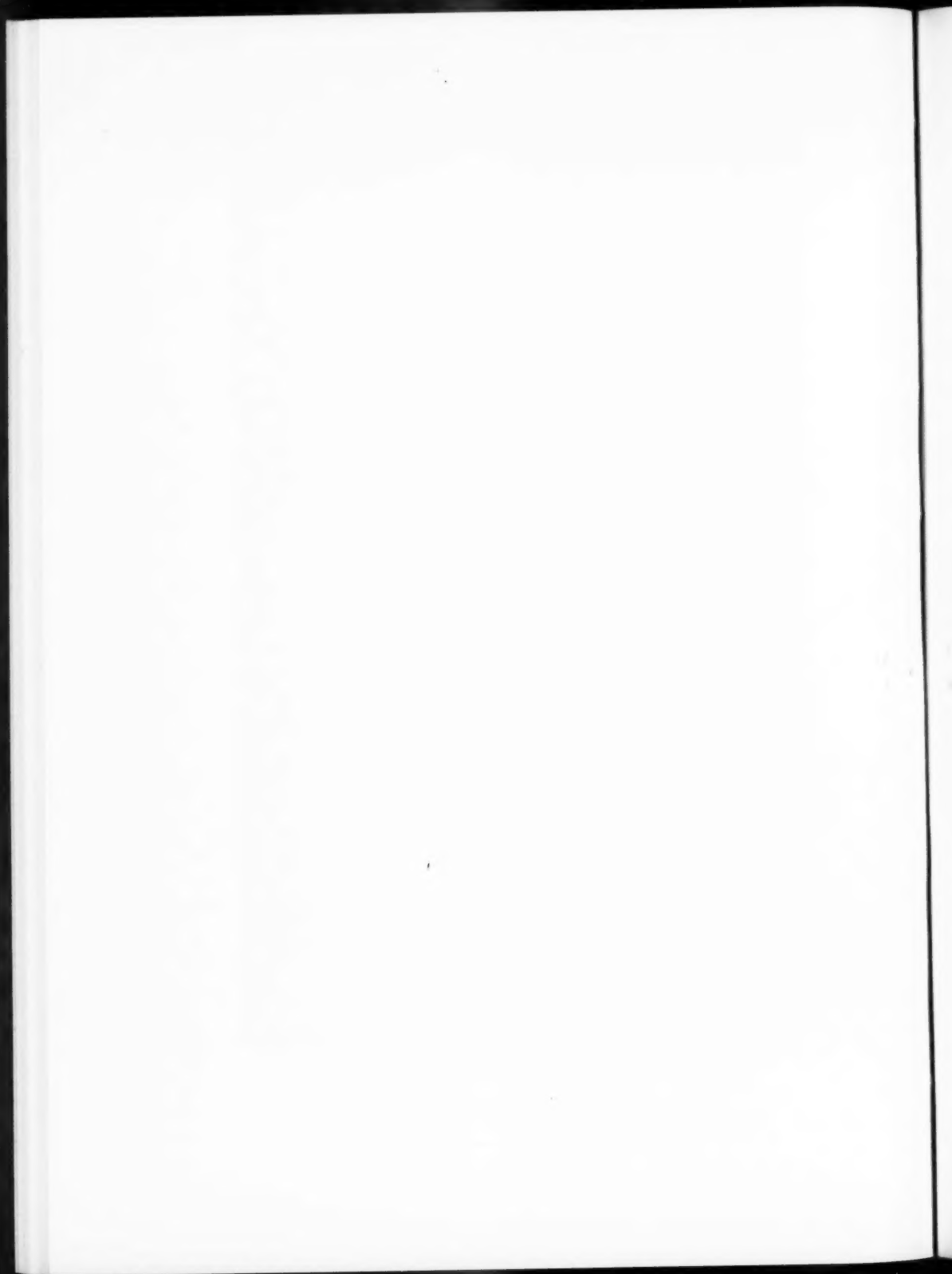
Fig. 6

Fig. 4. *Goniadoris mercuvialis* n. sp.

Fig. 5. *Goniadoris brunnea* n. sp.

Fig. 6. *Okenia amoenula* Bergh.

All painted from nature.



FURTHER NOTES ON MYSIDACEA FROM SOUTH AFRICAN WATERS

BY OLIVE S. TATTERSALL, D.Sc.

(Communicated by J. H. DAY)

(With three text-figures)

(Read April 17, 1957)

Three species new to science are described: *Gastrosaccus psammodytes* and two species that belong either to the genus *Mysidopsis* or to a closely allied genus. Five of the species in the collection are new records for South African waters; these considerably extend the known geographical range: *Siriella jaltensis* Czerniavsky, *Gastrosaccus dunckeri* Zimmer, *Afromysis hansonii* Zimmer, *Afromysis australiensis* Tattersall, and *Acanthomysis indica* (Tattersall).

I am very much indebted to Mr. A. C. Brown of the Department of Zoology, University of Cape Town, for the opportunity of examining this small collection of Mysidacea from the shores of South Africa.

Several species already well known from these waters are represented in the collection, and unless their known range has been extended by the present records, I have not included them in this report.

Five of the species in the collection are new records for South African waters as follows: *Siriella jaltensis* Czerniavsky, first record from the southern hemisphere; *Gastrosaccus dunckeri* Zimmer, previously known only from the eastern Indian Ocean and the Bay of Bengal; *Afromysis hansonii* Zimmer, first record from the Indian Ocean; *Afromysis australiensis* Tattersall, previously known only from New South Wales, and *Acanthomysis indica* (Tattersall), known previously from the Andaman Islands, the Gulf of Manaar and Portuguese India.

Three species represented in the collection are new to science, *Gastrosaccus psammodytes* which was found on several occasions buried in sand at low water in Hout Bay near Cape Town, and two species which belong either to the genus *Mysidopsis* or to a closely allied genus. Unfortunately each of these species is represented only by a single damaged female. It was not possible to dissect the animals nor to examine in detail those characters which are of generic significance. I have therefore described and figured them as far as was possible and referred them tentatively to the genus *Mysidopsis* without naming them. It is to be hoped that further specimens will be forthcoming in the future so that their true taxonomic position may be ascertained.

The types of the new species are lodged in the British Museum (Natural History), London.

Family MYSIDAE

Sub-family SIRIELLINAE

Genus *Siriella* Dana, 1850*Siriella jaltensis* Czerniavsky, 1868

Siriella jaltensis Czerniavsky, 1868, 66. *Siriella crassipes*, G. O. Sars, 1877, 97. *Protosiriella jaltensis*, Czerniavsky, 1882, 1, 110. *Cynthilia jaltensis*, Norman, 1892, 151.

Locality: Mossel Bay, South Africa (south coast), 12.1.56, dredge, 1 ovigerous ♀.

Remarks: This specimen agrees closely with the published descriptions of *S. jaltensis* in all respects except that the outer margin of the antennal scale is slightly concave.

Distribution: This species is common in all British waters, along the north and west coasts of France, in the Mediterranean, and in the Black Sea. It has also been recorded from the Cameroons off the west coast of Africa (Tattersall, 1927, 315). The present record, which is a new one for South African waters, very considerably extends its known geographical range.

Sub-family RHOPALOPHTHALMINAE

Genus *Rhopalophthalmus* Illig, 1906*Rhopalophthalmus terranatalis* O. S. Tattersall, 1957

Rhopalophthalmus egregius, O. S. Tattersall, 1952, 161, *nc* Hansen, 1910, 49, figs. *Rhopalophthalmus terranatalis* O. S. Tattersall, 1957, 98, figs.

Remarks: When working recently on a collection of Mysidacea from the Sierra Leone Estuary, I found large numbers of specimens of *Rhopalophthalmus* which could clearly be separated into two distinct species. Until then only two species had been referred to this remarkable genus—*Rhopalophthalmus flagellipes* Illig, which is characterized principally by its extremely long and slender eyes, and *R. egregius* Hansen. The eyes in both the Sierra Leone forms were much shorter and thicker than those in Illig's specimens.

The existing description of *Rhopalophthalmus egregius* was so incomplete and so indefinite in certain respects that it would have been reasonable to refer either of the Sierra Leone forms to it had not doubts been raised by the presence of the other.

Hansen's description of his types was based on damaged material and, probably as a result of this, he omitted to mention several characters of importance which later investigation has proved them to possess. The form of the telson and its unusual armature at the apex makes the members of the genus *Rhopalophthalmus* very easily recognizable, and this fact, together with the vagueness of the published description of *R. egregius*, has led workers to refer quite a large number of specimens from very widely separated localities to the species. These later workers had from time to time added details of characters which they had observed in their specimens but which had

not been mentioned in the original description of *egregius* so that they had been unable to make any comparisons with it.

I therefore decided to make a re-examination of all the material to which I could get access which had been referred to *R. egregius*. I was also fortunate enough to obtain permission to examine Hansen's types, and as a result of my investigations I found, as I had suspected, that several separate species were present in the material. I was able to give a survey of the genus as at present known and to describe and figure these new species (1957, 98-101).

When reporting on a collection of Mysidacea from estuarine waters of South Africa in 1952 (p. 161) I referred a number of specimens to *R. egregius* and pointed out certain details in which they differed from the published description of that species. At that time I did not consider that these differences constituted sufficient grounds for the institution of a new species for them. Comparison with other material and, above all, with the types of *egregius*, however, has now made it perfectly clear that these South African specimens do indeed represent a distinct species which I have described and figured under the name of *R. terranatalis*. When recording these specimens as *egregius* (1952, 162, fig. 3 A-H; 164, fig. 4 A-C) I gave full figures of them and when instituting the new species it was only necessary to reproduce these figures with the addition of a few amendments, the most important being the presence of median dorsal nodules on the carapace (1957, fig. 5 A).

Distribution: Richard's Bay, in 'D' net; south of Sundays River, 'D' net from sand flats; Knysna Lagoon, 'D' net in 3-5 metres, from mid-channel opposite Belvedere; Klein River Area and Lagoon, 'D' net in 5-10 ft. of water; Langebaan Bay, netted from weed on south side; Berg River Area, hand-net in salt marsh pool at high tide.

Rhopalophthalmus terranatalis is a gregarious form and in most of the above-mentioned records considerable numbers of specimens were taken in each haul.

Sub-family GASTROSACCINAE

Genus *Gastrosaccus* Norman, 1868

Gastrosaccus dunckeri Zimmer, 1915

Gastrosaccus dunckeri Zimmer, 1915, 165, figs.

Locality: Morumbene Estuary, Portuguese East Africa, 12.1.56, 1 adult ♂, 1 juv.

Remarks: This species may readily be recognized by the presence of a pair of extremely long, well-developed, reflexed lappets which arise from the posterior margin of the carapace and extend forward to the cervical sulcus. Similar lappets are present in *Gastrosaccus sanctus* (van Beneden) and *G. lobatus* Nouvel, but in both these species the lappets are relatively smaller than in *G. dunckeri*.

Distribution: This species was instituted by Zimmer for specimens in the Duncker collection in the Hamburg Natural History Museum. They were collected on a voyage from Ceylon to New Guinea.

W. M. Tattersall (1922, 459) recorded 57 specimens taken off Puri Beach, Orissa, Bay of Bengal. The present record is the first from the western region of the Indian Ocean.

Gastrosaccus psammodytes sp. nov.

Fig. 1 A-F

Localities: Station C.P. 351 A, 1.11.51, Buffel's Bay, Cape Peninsula. 1 ♂, not fully adult, 11.6 mm., 2 ovigerous ♀♀, 14.5 mm. *TYPES.* Station C.P. 460 D, 11.4.56, buried in sand in Hout Bay, Cape Peninsula, 1 ovig. ♀, 14.5 mm.; Station C.P. 462 D, 25.4.56, in sand, Muizenberg, 2 ovig. ♀♀, 14.3 mm., 1 juv. ♀. Station C.P. 463 C, 25.4.56, in sand near low water at Spring tide, Muizenberg, 1 imm. ♂, 9 mm.; Station C.P. 468 C, 24.5.56, in sand, Milnerton, Cape Province, 1 juv. ♂, 6.8 mm.

Description: Integument smooth; Carapace very large, extending posteriorly to cover the whole of the thorax and the first abdominal somite in lateral view; anterior margin produced to form a short, bluntly rounded rostral plate leaving the eyes wholly uncovered. The anterior portion of the rostrum is curved downward between the eyes and, as a result, appears in dorsal view to be truncate and considerably shorter than it actually is (fig. 1 A); posterior margin of carapace deeply and narrowly emarginate, the posterior half of this emargination is cut up to form a large, rounded, forwardly directed lobe which partially overlaps the more proximal portion of the emargination on each side (fig. 1 A-C).

Antennules long and relatively slender; outer margin of second segment usually armed with three strong spines but in a few specimens there are four spines present (fig. 1 A).

Antennal scale small, extending almost to the distal end of the second segment of the antennular peduncle; tooth terminating the unarmed portion of the outer margin strong and extending beyond the small rounded apex; small distal suture present. *Peduncle* relatively long, extending beyond the distal margin of the second segment of the antennular peduncle and over-reaching the scale itself (fig. 1 A).

Eyes small, set widely apart, extending to about the middle of the first segment of the antennular peduncle; cornea occupying the terminal portion of the organ and symmetrically seated on the eyestalk (fig. 1 A).

There is nothing distinctive about the thoracic appendages.

Pleopods of the male of the *spinifer* type, i.e. the endopods of the third pair, are multi-articulate and furnished with plumose setae as in the second pair; exopod very long and composed of four segments. The male specimens are immature and I am not able to distinguish the three or four small articulations at the proximal end of the exopod which are found in other species of the *spinifer* type in the genus; of the female first pair unusually long with the sympod somewhat expanded and armed at its distal end with a group of four extremely long, densely plumose setae. I cannot see the group of setae at the proximal end of the sympod which is so characteristic of *G. sanctus* and other species of the genus; exopod oblong, armed as in figure 1 D; endopod with

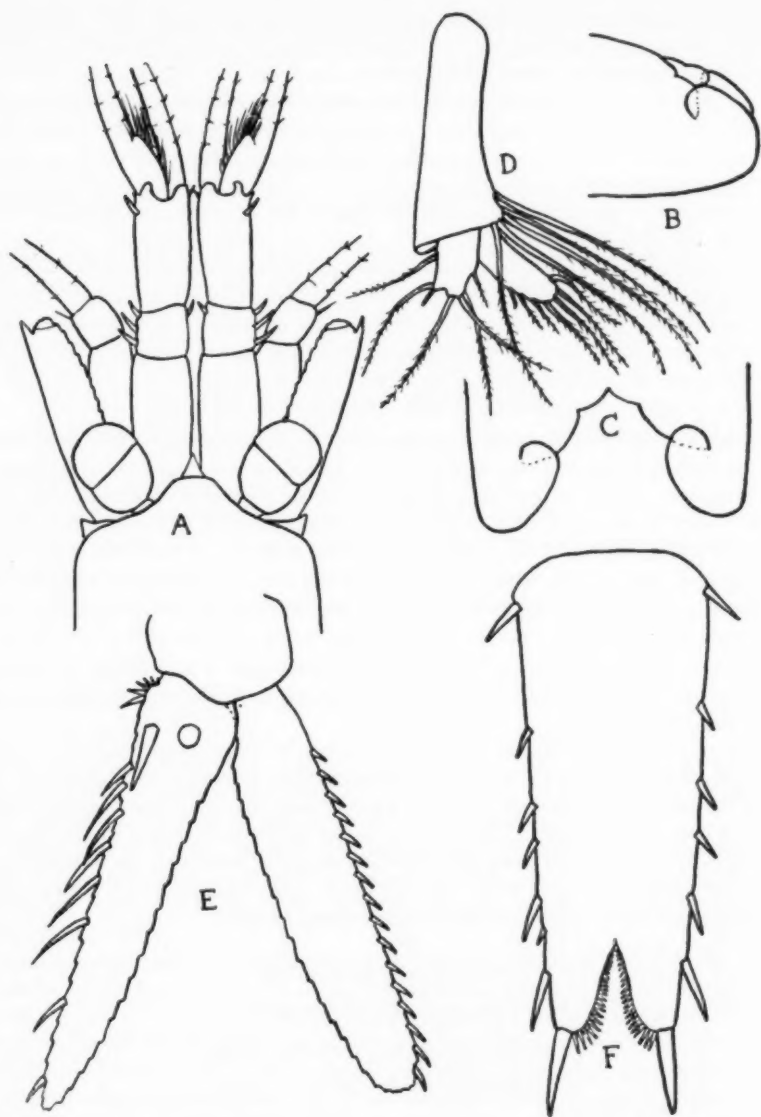


FIG. 1. *Gastrosaccus psammodytes* n. sp.

A. Anterior end of adult female $\times 30$. B. Posterior end of carapace in lateral view $\times 40$.
 C. Posterior end of carapace in dorsal view $\times 30$. D. First pleopod of female $\times 55$. E. Left
 uropod from ventral side $\times 40$. F. Telson $\times 30$.

parallel sides and rounded distally, armed with 7-8 graduated setae. Remaining pleopods in the female reduced to simple plates which become progressively smaller on the posterior abdominal somites (fig. 1 D).

Uropods with the exopod slightly longer than the endopod; armed on its outer margin with 16 strong regular spines; endopod extending to about the middle of the long apical spines of the telson; armed along the inner margin with 8 long, slender, curved, somewhat irregularly spaced spines and with a row of 6 small graduated, closely set spines at the extreme proximal end of the inner margin proximal to the statocyst (fig. 1 E-F).

Telson subequal in length with the sixth abdominal somite; less than three times as long as broad at the base; lateral margins armed with 6 strong, somewhat irregular spines. In the larger animals there may sometimes be one or two very small spines interspersed among the large spines; apical spines very long and strong; *cleft* less than one-fifth of the length of the telson (fig. 1 F).

Size: Adult ovigerous females 14.2-14.3 mm.

Remarks: This species may be distinguished from *Gastrosaccus vulgaris* Nakazawa, which it resembles in many respects, by the large rounded lobes on the posterior margin of the carapace; by the form of the endopod of the third pleopod of the male which in *vulgaris* is composed of only two segments (in the largest male specimen of *G. psammodytes* the endopod is not fully developed but four distinct segments can be made out and undoubtedly in the adult male there would be more segments in this limb); by the larger number of spines arming both the exopod and endopod of the uropod and, especially, by the form of the apical lobes and the deeper cleft of the telson.

Habits and distribution: Mr. A. C. Brown, who is engaged in an Ecological Survey of the Beaches of the Cape Peninsula, has kindly informed me of the following facts concerning this species:

G. psammodytes is common on those beaches of the Peninsula which are exposed to wave-action. During the day it lies buried in the top inch or so of sand from low-water to about mid-tide level and has been obtained in large numbers by sieving (over 100 in 35 × 35 cm.). It is nocturnal in its habits and swims about in the water at night, when it may be taken in shallow water with a hand-net. However, it is still possible to take it at night by sieving, above the level reached by the waves. When placed on wet sand it burrows tail-first with great rapidity.

Sub-family MYSINAE

Tribe LEPTOMYSINI

Genus *Mysidopsis* G. O. Sars, 1864

Mysidopsis similis (Zimmer), 1912

Paramysidopsis similis Zimmer, 1912, 6. *Leptomysis tattersalli* O. S. Tattersall, 1952, 177. *Mysidopsis similis* O. S. Tattersall, 1955, 157.

Localities: False Bay, 24.11.46; 5.12.46. Langebaan Bay, 4.5.46. Dassen Island, 5.12.46.

Distribution: The types of this species were taken off Angra Pequena, South West Africa. It has since been recorded from near the mouth of Knysna Lagoon; Langebaan Bay (Tattersall, 1952, as *Leptomysis tattersalli*); False Bay (Tattersall, 1955). The present records do not extend its known geographical range.

Mysidopsis major (Zimmer), 1912

Paramysidopsis major Zimmer, 1912, 7, figs. *Mysidopsis major* O. S. Tattersall, 1955, 157.

Locality: False Bay, 20.9.50; 4.8.55 (Zimmer); False Bay (Tattersall, 1955).

Distribution: This species was originally taken in considerable numbers in company with *Mysidopsis similis* and *M. schultzei* among weeds in Luderitz Bay near Angra Pequena. It has since been captured on a few occasions in False Bay.

Mysidopsis schultzei (Zimmer), 1912

Paramysidopsis schultzei Zimmer, 1912, 5, figs. *Mysidopsis schultzei* O. S. Tattersall, 1955, 156, figs.

Locality: False Bay, 20.9.50.

Distribution: This species was first captured in company with *M. similis* and *M. major* off Angra Pequena, and has since been taken on two occasions in False Bay, Cape Peninsula.

? *Mysidopsis* species A

Fig. 2 A-D

Locality: Mossel Bay (South Africa, south coast); 1 ovigerous ♀, 3.8 mm., not in good condition.

Description: *Carapace*. Anterior margin produced into an acutely pointed triangular rostrum which leaves the eyes wholly uncovered and extends forward to the middle of the second segment of the short antennular peduncle (fig. 2 B).

Antennules small and relatively very short; outer anterior angle of first segment produced forward into a long finger-like process which extends beyond the proximal margin of the third segment and is armed at its apex with two small slender setae (fig. 2 A-B).

Antennae scale broad and leaf-like; more than half as long again as the antennular peduncle; somewhat more than twice as long as its greatest width; outer margin slightly convex; inner margin very convex; proximal third of outer margin devoid of setae with no spine or thorn marking the distal end of the unarmed portion; small distal suture present. Outer distal angle of sympod produced into a thick, conspicuous, blunt, finger-like process similar in form to that from the first segment of the antennular peduncle (fig. 2 B-C).

Eyes very large and somewhat flattened dorso-ventrally (fig. 2 B).

Thoracic appendages: As far as can be seen without dissection the endopods of the first pair are of the form of those characteristic of members of the genus *Mysidopsis*,

that is, with the praeischium and ischium fused and the endopod composed of only six segments with no endites; remaining endopods short and strong with the merus relatively long and the carpo-propodus divided by vertical articulations into three sub-segments; dactylus extremely small and bearing a relatively strong nail.

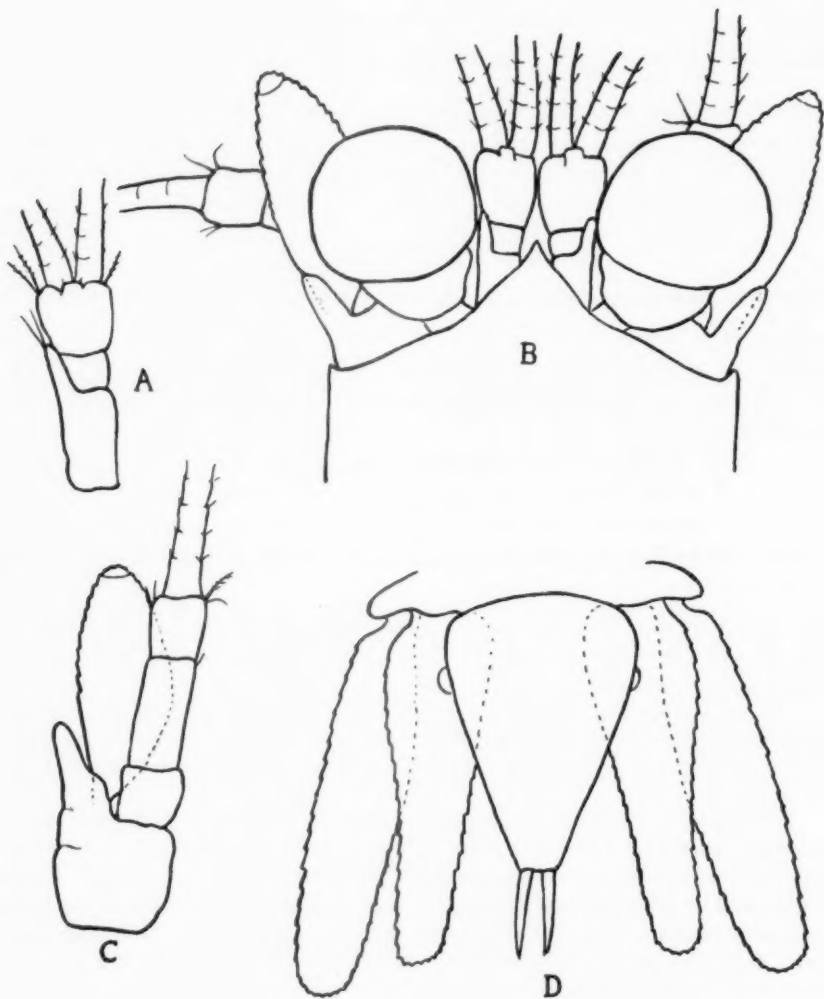


FIG. 2. ? *Mysidopsis* sp. A

A. Antennule $\times 80$. B. Anterior end of female $\times 80$. C. Antenna $\times 80$.
D. Telson and uropods $\times 80$.

Pleopods in the female small and oblong in shape, with no proximal dilation.

Uropods short and relatively broad. I am unable to see any spines arming the endopod (fig. 3 D).

Telson in the form of a long isosceles triangle with the lateral margins unarmed, straight and converging evenly to the narrow truncate apex which is armed with two long spines. There is no trace of median setae.

Length of ovigerous female, 3.8 mm.

Remarks: I am undecided about the correct taxonomic position of this unusual specimen. In general appearance, in the form of the anterior end of the animal and of the thoracic appendages (as far as one can see without dissection), in the female pleopods and the uropods it agrees closely with the diagnosis of the genus *Mysidopsis*. There are, however, two characters which mark it off sharply from this genus and which suggest an affinity with certain species of genera belonging to the tribe Erythropini. I refer to the armature of the antennal scale with the proximal portion of the outer margin unarmed and to the shape and armature of the telson.

In all the known species of *Mysidopsis* the antennal scale is setose all round with no portion of its margins unarmed. Also in the known species of *Mysidopsis* the lateral margins of the telson are armed throughout their length with a varying number of small regular spines and the apex is either somewhat pointed or is bluntly rounded. The telson in the present specimen with its completely unarmed lateral margins and narrow truncate apex is most unlike anything found in the genus.

Until more material is available so that the mouth parts and thoracic endopods and, above all, the pleopods of an adult male can be dissected and investigated in detail the true systematic position of this new species must remain in doubt. For the present I doubtfully refer it to the genus *Mysidopsis*.

? *Mysidopsis* sp. B

Fig. 3 A-F

Locality: Langebaan Bay, 6.5.55, 1 damaged immature ♀, 4.2 mm.

Description: General form short and relatively robust, especially in the anterior region.

Carapace with the anterior margin produced into a short triangular rostrum extending to about the middle of the eyestalk; antero-lateral angles rounded and produced so as to form definite 'shoulders' in dorsal view (fig. 4 A).

Antennules short and relatively robust with the third segment longer than the first (fig. 3 A).

Antennae. Scale broadly oval; setose all round; slightly more than twice as long as its broadest part (fig. 3 A).

Mandibles with the palp robust; second segment broad and robust; third segment broad at the proximal region with the inner margin deeply concave for the distal two-thirds of its length and armed with three or four strong, spaced spines and with a strong, curving plumose seta at its apex (fig. 3 B).

First thoracic endopod relatively very robust; ischium and praeischium fused as in the species of *Mysidopsis*; no endites present; dactylus short and broad, armed with a very strong stout nail and a few strong spaced spines (fig. 3 C).

Second thoracic endopod more slender than the first thoracic endopod with the carpo-propodus swollen (fig. 3 D).

Remaining thoracic endopods short and more slender than the first two pairs; merus long; carpo-propodus composed of three subsegments; well-developed nail present (fig. 3 E).

Uropod short and broad, exopod relatively very broad with broadly rounded apex; endopod shorter than the exopod. I am unable to see any spines arming the endopod (fig. 3 F).

Telson trapeziform; slightly longer than the sixth abdominal somite; very slightly longer than broad at the base; lateral margins nearly straight and unarmed except

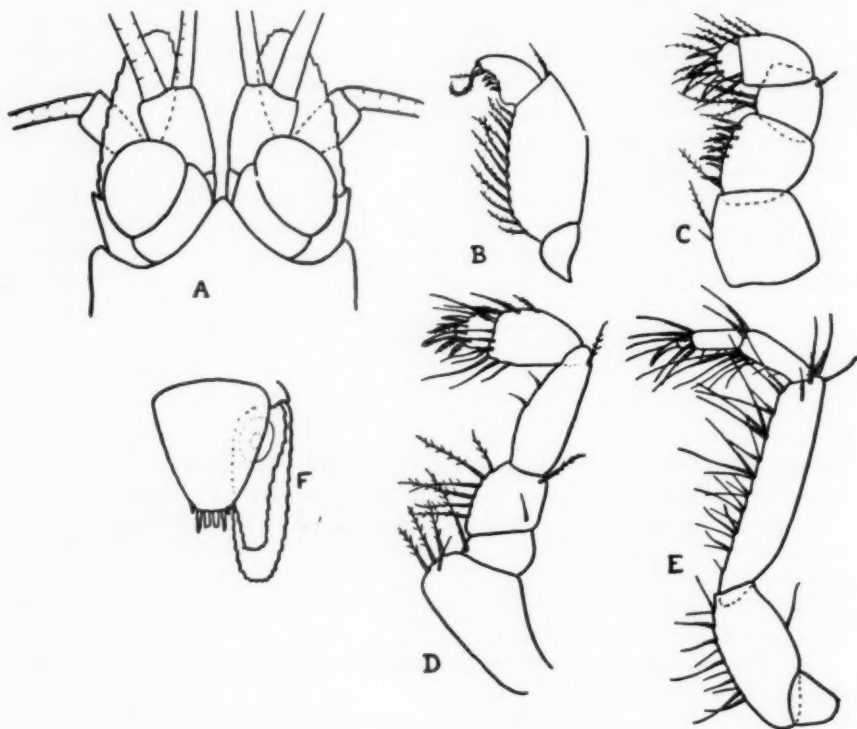


FIG. 3. ? *Mysidopsis* sp. B

A. Anterior end of immature female $\times 40$. B. Mandibular palp $\times 80$. C. First thoracic endopod $\times 80$. D. Second thoracic endopod $\times 80$. E. Fourth thoracic endopod $\times 80$. F. Telson and right uropod $\times 40$.

for a minute spine on each side close to the broadly rounded apex. The specimen is immature and it may be that with growth more spines may develop on the lateral margins. Apex armed with a pair of slender spines and the bases of two spines or strong setae which have been broken off. From the thickness of these basal portions these spines or setae must have been much larger than the outer pair of spines.

Length of immature female with small oostegites, 4.2 mm.

Remarks: This specimen agrees with the published diagnosis of the genus *Mysidopsis* in all the characters which I have been able to observe except for the absence in it of spines arming the lateral margins of the telson. This may be due to the immaturity of the animal. I have not been able to examine the form of the maxilla or to ascertain whether there is an exopod present in that appendage. I am therefore not able to tell whether the specimen should be referred to the genus *Metamysidopsis* which is characterized by the absence of an exopod in the maxilla and by the spines arming the lateral margins of the telson being confined to the distal region with the proximal portions of the margins unarmed. In the known species of the genus *Metamysidopsis* the antennal scale is narrowly lanceolate in form, tapering to a very slender apex, quite unlike the present specimen.

In the absence of male specimens and until undamaged adults of both sexes can be examined I do not feel justified in instituting a new species for this specimen, which I refer doubtfully to the genus *Mysidopsis*.

Genus *Afromysis* Zimmer, 1916

Afromysis hansonii Zimmer, 1916

Afromysis hansonii Zimmer, 1916, 63, figs. *Afromysis hansonii* O. S. Tattersall, 1955, 166.

Locality: Plankton in Durban Bay, 23.4.52, 1 juv. ♂, 5 juv. ♀♀.

Remarks: The types of this species were taken from the stomach of *Trigla capensis* which was captured in Walvis Bay at a depth of 4.57 metres. Specimens of the species were taken on two occasions by the ships of 'Discovery' Investigations. The first of these captures was made in exactly the same circumstances as that of the types—from the stomach of a specimen of *Trigla capensis* taken in Walvis Bay. The second was found in plankton from off Cape Lopez in French Equatorial Africa.

The occurrence of the species off Durban very considerably extends its known geographical range.

Although the present specimens are very small and immature the form of the distal segment of the palp of the maxilla is exactly as figured by Zimmer for the types and as in the 'Discovery' specimens.

Afromysis australiensis W. M. Tattersall, 1940

Afromysis australiensis W. M. Tattersall, 1940, 336, figs.

Locality: Dredged in Mossel Bay, 16.1.56, 1 adult male, broken into two pieces.

Remarks: This species was founded on specimens from Broken Bay, New South Wales, and has since been recorded from the same locality. The present specimen, although broken, is in good enough condition to make its identification possible. It agrees very closely with the published description and figures of *australiensis*, especially in the form of the palp of the maxilla, the uropods and the telson. Its occurrence in Mossel Bay greatly increases its known geographical range.

Tribe MYSINI

Genus *Acanthomysis* Czerniavsky, 1882,

Acanthomysis indica (W. M. Tattersall), 1922

Neomysis indica W. M. Tattersall, 1922, 483, figs.

Locality: Dredged in Mossel Bay, 20.1.56, 1 adult ♂, 5.6 mm., 3 juv. ♂♂, 2 ovigerous ♀♀, larger 6 mm., 2 juv. ♀♀, 3.6 and 4.4 mm.

Remarks: These specimens agree closely with the published description and figures of *A. indica* in the proportions and general form of the anterior end and its appendages and in the shape and armature of the uropods and telson. The only differences which they show from the types are as follows:

1. The integument appears to be quite smooth in both adults and juveniles, whereas Tattersall (1922, p. 485) describes the animals as 'hispid all over, the spinules thickest on the posterior segment of the abdomen and on the anterior part of the thorax'.
2. The eyes in the present specimens are relatively larger than in the figure of the types.
3. The base of the telson is armed with two unequal spines on each side in the present specimens but in the Australian specimens there are three small equal spines in this position.

In view of the very close resemblance of these South African specimens to *A. indica* in all other characters I do not consider that these small differences are sufficient to justify the institution of a new species for them.

Distribution: Port Blair, Andaman Islands; Kilakarai, Gulf of Manaar; Mormugão Bay, Portuguese India. The capture of these specimens off the east coast of South Africa considerably extends its known range to the westward.

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